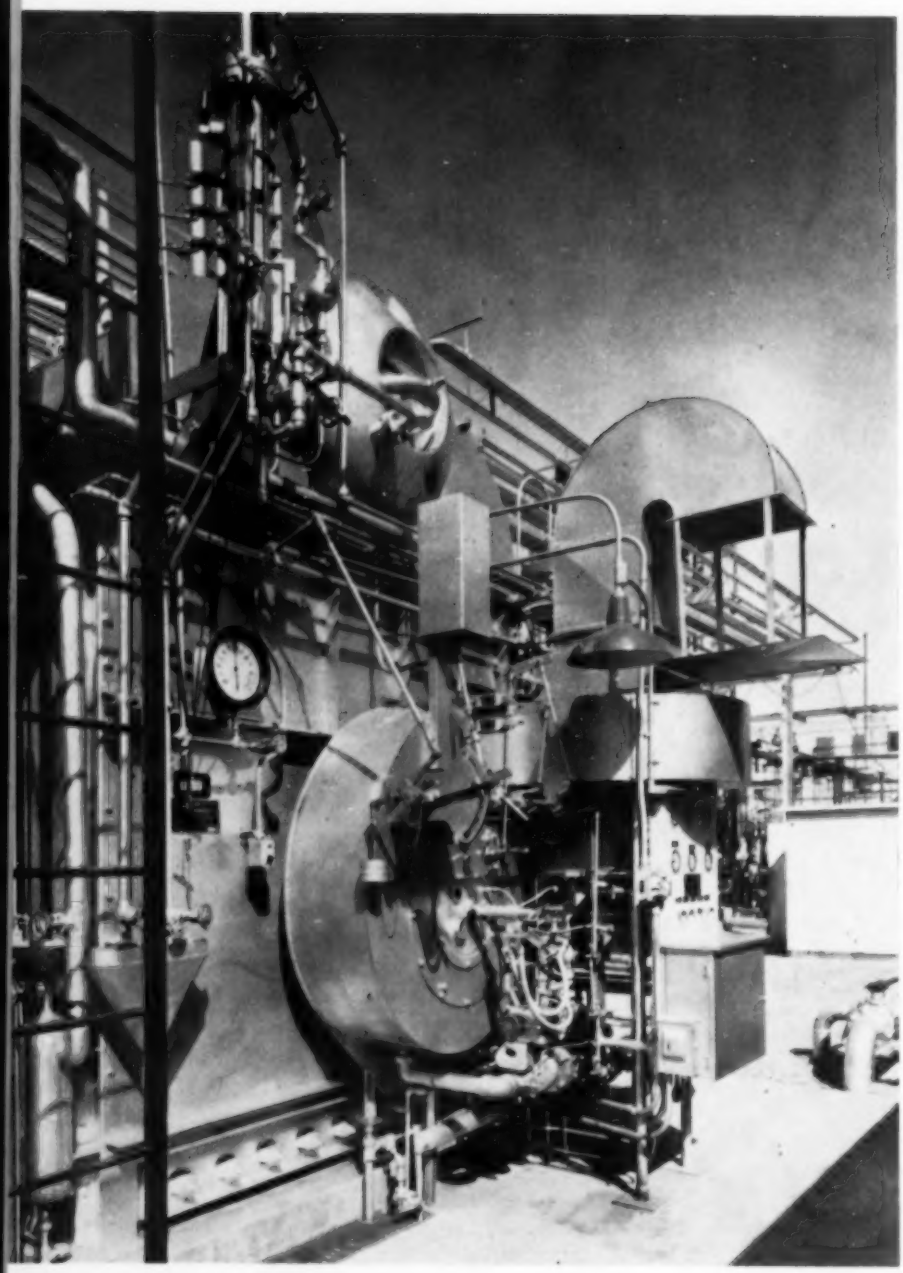
Industry and Power



March 1955

Outdoor Packaged Boiler
Shell Development selects an oil and gas fired packaged unit for its Emeryville Lab. 35

D-C to A-C Changeover
The Electrical Engineer at Parke-Davis tells how to keep going during a changeover .. 40

Variable Speed Drives
New mechanical drives give a wide range of variable speeds for industrial applications 44

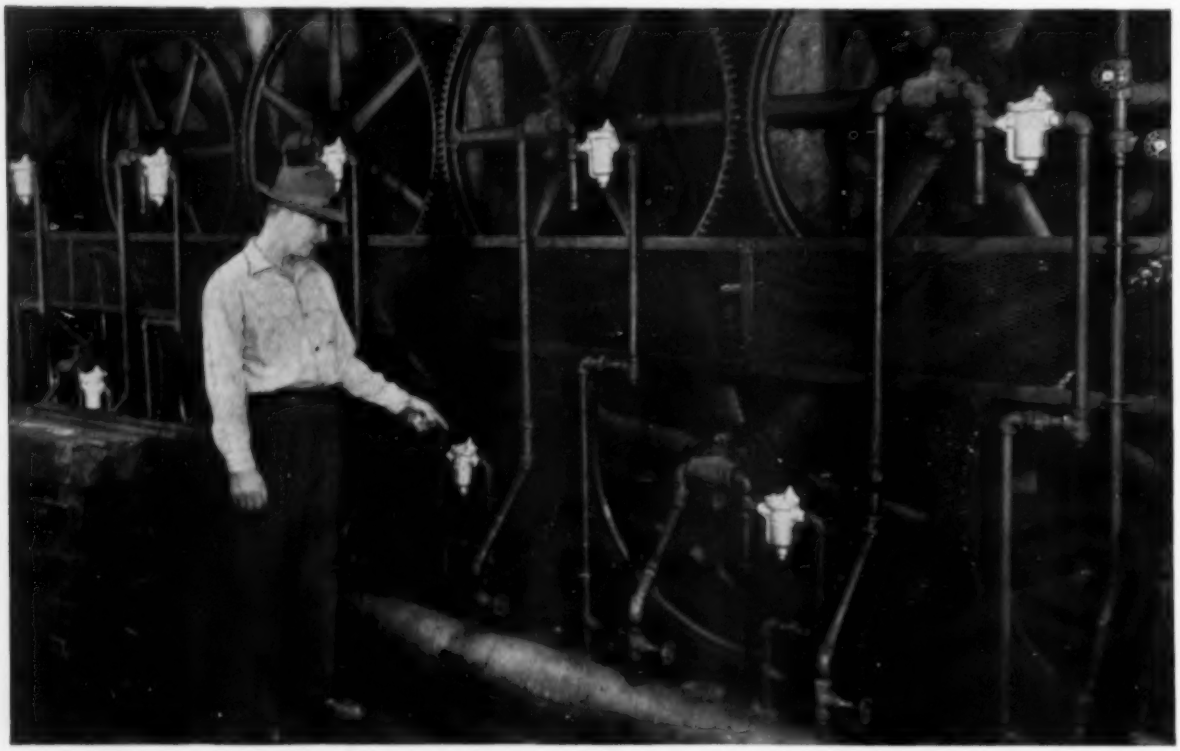
Refrigeration Piping
Proper piping layout is vital to efficient operation of a refrigeration system 48

Specific Speed Chart
An original chart to simplify solution of "specific speed" for centrifugal pumps 54

Pneumatic Handling
New system is result of ten years' experience in pneumatic bulk materials handling 59

Coal Fired Packaged Unit — Page 64

The Steam Traps That Didn't Cost a Penny . . .



10% Fuel Savings Paid for These Armstrongs

Nobody loves the coal man—When you can save 2000 to 3000 pounds of coal per day, it doesn't take long to completely pay for an Armstrong steam trap installation. That's the way it worked at Beloit Boxboard Co., Beloit, Wisconsin. Mr. Edward Kasten, Plant Engineer, is shown above pointing to a No. 812 Armstrong trap, list price $23. Every 3 or 4 days one of the traps pictured was paid for in full at the expense of the coal man. For a bonus, there had been absolutely no repair costs on these traps at the end of three years service.

Are such savings common?—More often than not, the replacement of leaky or obsolete or improperly sized steam traps with new Armstrongs results in worthwhile fuel savings. Some of the best engineered plants in the country have experienced this.

The reasons—Start with a good steam trap design. Add to it shop men who have made more industrial steam traps than any other group in the world. Then, add to that the best trained, most experienced trap sales-engineering group in existence. Season the whole affair with the Armstrong unconditional guarantee of "complete satisfaction or your money back". You can't buy any product anywhere with closer to 100% assurance that it is going to give you good results. In the case of steam traps, one of those results is often fuel savings.

Why not take another good look at your trapping? Call your local Armstrong Factory Representative (listed in many classified phone directories and in Thomas Register), or write to Armstrong Machine Works, 820 Maple St., Three Rivers, Michigan.

Application Engineered

ARMSTRONG STEAM TRAPS

ASK FOR CATALOG J

. . . the 44-page "Steam Trap Book" is really a handbook of steam trapping—trap data plus selection, installation and maintenance information. Free on request without obligation.

Armstrong traps also catalogued in Sweets and Chemical Engineering Catalog.

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are RELIABLE *and* ECONOMICAL *to operate*

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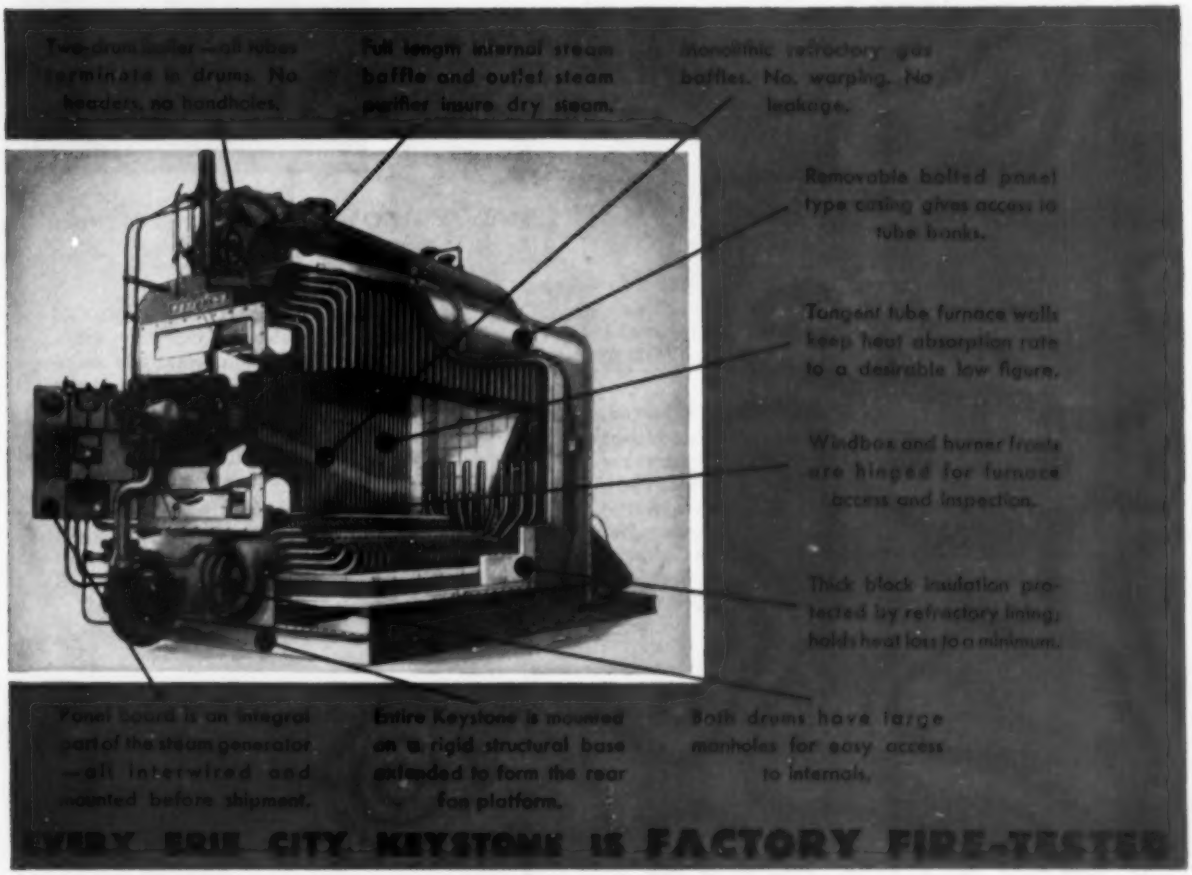
- **5 Sq. Ft. of heating surface per developed H. P.**
- **Fully automatic controls**
- **All piping and wiring at the factory**
- **Ease of installation**
- **Low cost maintenance**


Two-drum boiler—all tubes terminate in drums. No headers, no handholes.
Full length internal steam baffle and outlet steam purifier insure dry steam.
Monolithic refractory gas baffles. No warping. No leakage.
Removable bolted panel type casing gives access to tube banks.
Tangent tube furnace walls keep heat absorption rate to a desirable low figure.
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Panel board is an integral part of the steam generator—all interwired and mounted before shipment.
Entire Keystone is mounted on a rigid structural base extended to form the rear fan platform.
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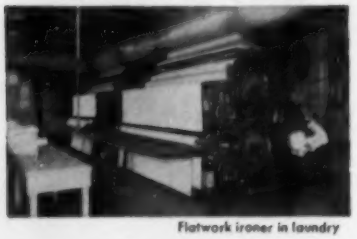
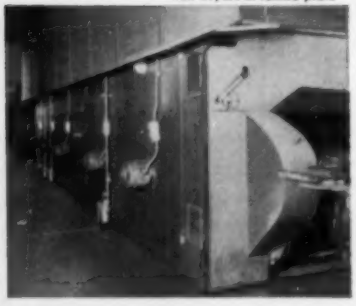
Corrugator in paper board mill



Flatwork ironer in laundry

Felt dryers in textile plant



Production UP 30%
Steam costs DOWN 40%

You may not believe it . . . but we'll prove it!

When a prominent chemical manufacturer installed a Cochrane C-B System on a dryer for titanium dioxide, production went from 45 to 65 tons per day—*a gain of 30%*. Steam consumption decreased from 12,000 to 7,000 lbs./hr.—*reducing steam cost 40%!*

This example is not unusual. In process industries, paper board mills, laundries, or wherever steam is used for heat transfer, over 2000 Cochrane C-B Systems are setting new standards of production. Higher output, improved product quality, unbelievably improved equipment performance, longer service life, fuel savings, reduced maintenance . . . these are the benefits a Cochrane C-B System gives you. They all add up to increased production efficiency—a vital factor in insuring your share of today's competitive markets.

Unless your condensate drainage is handled by a C-B "Closed System", it is almost certain that your steam and heat transfer equipment is *not* operating at maximum efficiency. By draining condensate at jet speed, the C-B System assures faster, more uniform heat transfer in both old and new equipment and gives outstanding savings by discharging steam at higher temperatures directly to the boilers or the make-up facilities.

You may still be skeptical . . . but these are facts and *these results mean money in your pocket.* So, why not spend a few minutes to find out the complete story? Write us TODAY for Publication No. 6025 on C-B Condensate Drainage Control Systems.

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Volume 68 **March 1955** Number 3

FEATURE ARTICLES

Shell Selects Package Boiler for Outdoor Operation . . 35
Temple S. Voorheis, Chief Engineer, Coen Company

How We Scheduled a D-C to A-C Changeover 40
Murphy Shell, Manager Electrical Engineering, Parke, Davis & Co.

New Drives Give Wide Range of Variable Speeds 44
Richard LeB. Bowen Jr., Coated Textile Mills, Inc.

Planning Refrigeration Plant Piping Systems 48
C. T. Baker, Consulting Engineer

How to Select Control Switchboards 51
Roy Holland & Frank Nolan, Switchgear Dept., Allis-Chalmers Manufacturing Company.

Specific Speed Chart for Centrifugal Pumps 54
Roy Carter and Igor J. Karassik, Centrifugal Pump Div., Worthington Corporation

Pneumatic Bulk Handling 59
P. R. Inglis, Chief Engineer, Ward Baking Company

Packaged Units for Coal Firing 64
G. A. Rehm, Chief Engineer, Springfield Boiler Company

Cover Illustration — Coen Company
See story page 35

DEPARTMENTS

Acorns 6
New Equipment 10
Letters From Readers 26
New Bulletins 28
Out Our Window 32
Ideas in Action 72
Readers' Guide 78
Names Make News 92
Meetings 94
Classified Advertising 96
Available Reprints 96
Advertisers' Index 98

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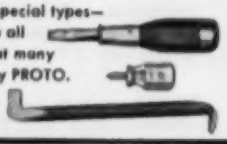

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acorns

. . . recently announced . . . worth watching

Aluminizing Iron and Steel Wire

● The Page Steel and Wire Division, American Chain & Cable Company, Inc. has developed a continuous hot-dip aluminum coating process for iron and steel wire based on the fluxing action of complex salt compounds applied to the wire surface from a hot aqueous solution. These aluminum coatings offer resistance to heat oxidation at relatively high temperatures. Outdoor exposure tests in both industrial and highly humid atmospheres indicate that aluminum coatings are substantially superior to equivalent thicknesses of zinc coatings although salt spray corrosion test data show less pronounced differences.

Conductive Rubber

● Electrically conductive rubber has important applications as an eliminator of static electricity in rubber drive belts. Tests being carried out by the U. S. Arsenal, Rock Island, were developed to measure the ability of a rubber compound to dissipate static electricity under service conditions. They indicate that the new super abrasion furnace (SAF) blacks are superior to acetylene blacks as dissipating agents.

Cold Metals Testing

● Westinghouse research metallurgists are conducting tensile tests on metals at temperatures as low as –452 F. A new testing chamber, which is only slightly larger than a hand fire extinguisher, is believed to be the first of its kind to use liquid helium as a refrigerant. A sample of the metal to be tested, about one inch long, and ¼ inch in diameter, is placed inside the special vacuum insulated chamber. Gripping it at either end are two special chucks, made from an alloy which has been found to withstand low temperatures and high stresses for extended time periods. Liquid nitrogen is forced into the chamber to cool it to about –320 F after which liquid helium is introduced to drop the temperature to –452 F. The load is applied to the chucks until the piece of metal being tested breaks. The studies are expected to provide information that will improve the understanding of brittle failures such as have occurred in welded steel hulls of ships when at sea.

Impact Grinding

● A new method of machining hard and brittle materials by ultrasonics has been developed by Raytheon Manufacturing Co. The instrument, which employs the magnetostriction principle to vibrate a cutting tool at an ultrasonic rate, cuts intricate shapes in hardened steel, glass, ceramics, and tungsten carbide. The cutting tool, energy for which is generated by vacuum tubes, moves at a rate of more than 25,000 strokes a second, traveling only a few thousandths of an inch up and down. Cutting is done by tiny abrasive particles which are driven into impact with the work as they move over the object in liquid suspension.

Vaporized Rust Inhibitors

● Volatile rust inhibitors have simplified the packaging, storage, and shipment of military equipment and replacement parts. The Naval Research Laboratory reports this development will make great economies possible because of the simplification of the procedures connected with the removal of oil or grease preservatives before placing equipment into service. The report summarizes information available on the properties, applications, and performance of more than 100 amine salts of weak inorganic acids and organic-amine complexes.

Carbon Monoxide Alarms

● A highly effective indicator that gives rapid and positive warning of sublethal concentrations of carbon monoxide is described in a report from the Army's Chemical Corps. The alarm operates satisfactorily at temperatures of from –40 to +125 F and under both salt-air and high-humidity conditions. Both visual and audible alarms operate continuously at concentrations of 200 (plus or minus 50) ppm. The alarms also operate whenever oxidizable foreign agents enter the combustion chamber, thus protecting against toxics other than carbon monoxide.

"a lady likes her hot bath Rust-Free"

a p-k cement-lined water heater supplies it economically for Elsie

Rust-free hot water is essential for dairy cleaning operations and the Borden Ice Cream Plant in Wilmington, Delaware, gets an abundance of it from a **p-k** cement-lined hot water storage heater.

This 1200 gal. capacity unit provides hot water for the nightly washdown of all the dairy's process equipment. It heats 5400 gph from 40 deg. F. to 180 deg. F., using steam at 100-lb. pressure.

The **p-k** heater is cement-lined to provide clean water for long life and low cost. A cement lining is applied over a tough metal lath welded to a carbon steel shell. Fortifying the outer steel shell against corrosion, it assures an ample supply of rust-free hot water. The heater meets all ASME specifications.

When you need standby hot water for intermittent demand in capacities from 180 to 10,000 gal., a **p-k** cement-lined hot water storage heater is an excellent investment.

Write for your copy of the **p-k** *Hot Water Heater Bulletin.*

The Patterson-Kelley Co., Inc.

1130 Burson Street, East Stroudsburg, Penna.

2915

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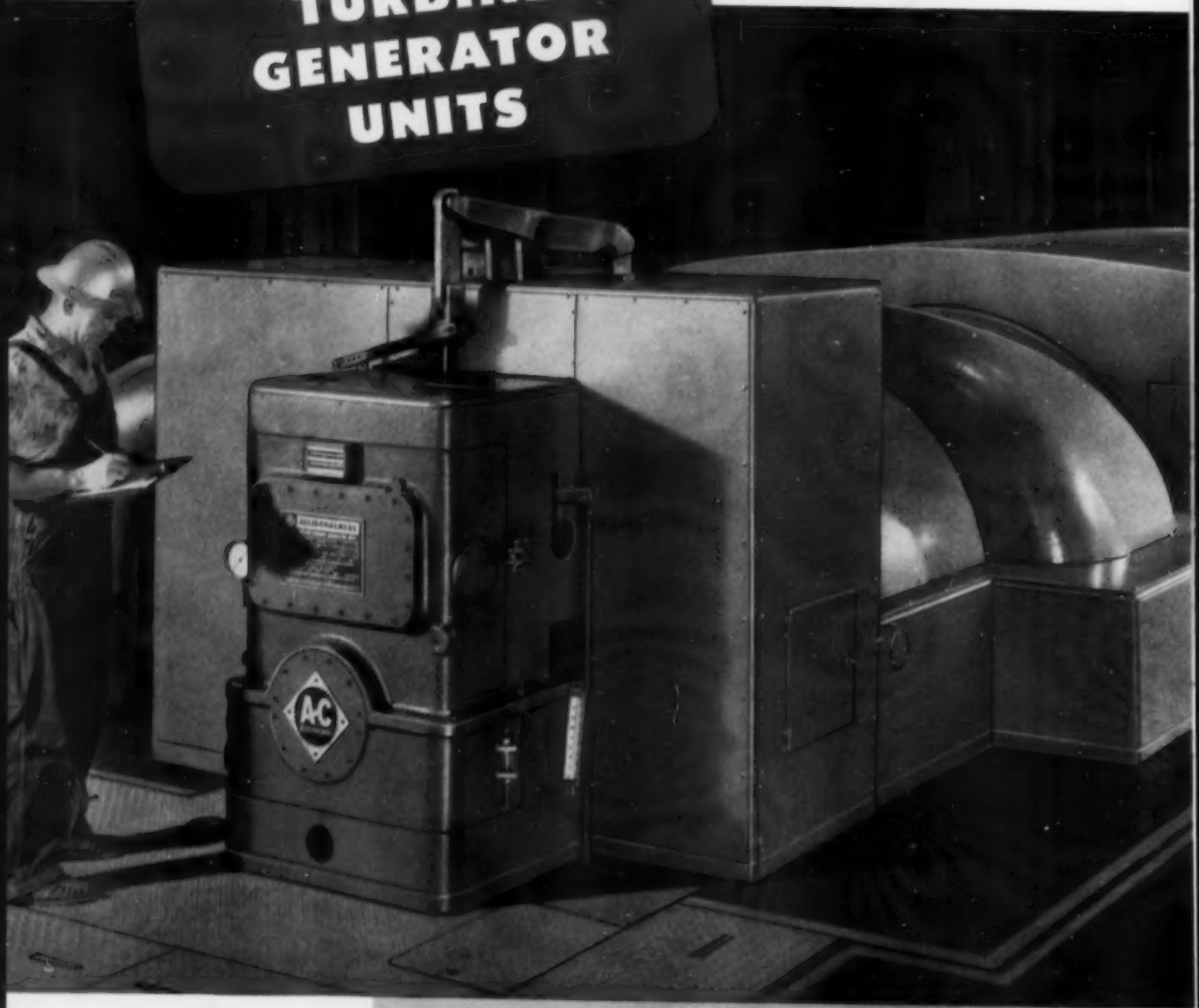
Choice for

WA-Series

STEAM TURBINE GENERATOR UNITS



COMPLETE POWER PLANT at Tuscola includes three boilers and two WA-Series steam turbine generator units, shown above. Allis-Chalmers also supplied condensers and condensate pumps for the plant.

ALLIS-

New $44,000,000 Petro-chemical Plant

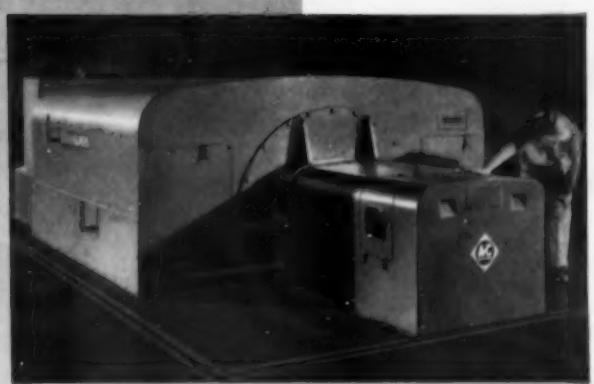
Two units generate power as by-product from steam required for processing natural gas

NATIONAL PETRO-CHEMICAL CORPORATION'S new Tuscola, Illinois, plant takes up to 425 million cubic feet of natural gas from the adjacent Panhandle Eastern pipeline, extracts 10 million cubic feet of ethane for cracking into valuable industrial chemicals, and returns the gas to the pipeline for transportation to big city customers.

To synthesize this huge amount of ethane into ethylene, hydrogen, and later into other useful components, fractionation and low temperature separation are used. The processes require 600,000 pounds per hour of steam, which is produced at 625 psig, 750 F.

Two condensing, automatic extraction WA-Series steam turbine generators are utilized to produce 10,000 kw of power from the steam before it is delivered into plant processes. The steam is delivered directly into the high temperature side of the automatic extraction impulse turbines, from which it is extracted at 65 psig for use in the plant. Each turbine generator unit is equipped with a housing-type, air-cooled generator and exciter. The entire units are carefully engineered and manufactured to operate as integrated units, 24 hours a day, 7 days a week.

WA-Series steam turbine generator units match the most modern plant design to provide high efficiency power or process steam. They are available in condensing or non-condensing types in NEMA ratings 2000 kw and larger. Bulletin 03B7654 gives complete facts. For your copy just call your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4477



OUTBOARD END of one unit shows exciter housing.

Simplified Installation and Maintenance

Every detail of WA-Series steam turbine generator units is designed for maximum simplicity and maintenance. Three-bearing construction, above-the-floor oil piping, and bracket-bearing, housing-type air-cooled generator are some of the features that result in a compact unit with simplified installation requirements. Turbine and generator are shipped with their rotors locked in place, further minimizing installation time.

Maximum reliability is assured by labyrinth spring-back steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and a time-proved governing system.

CHALMERS

A-C ALLIS-CHALMERS

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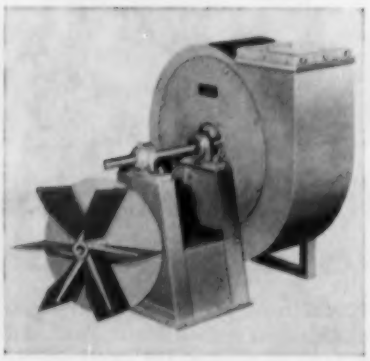
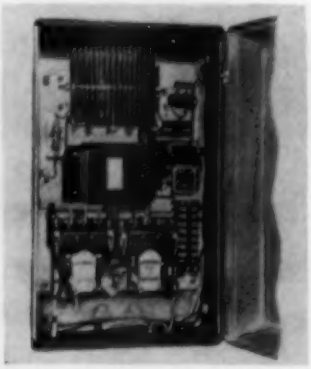
new equipment

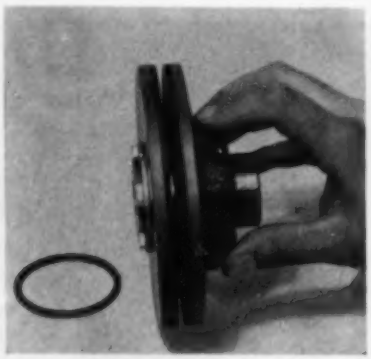
. . . new developments



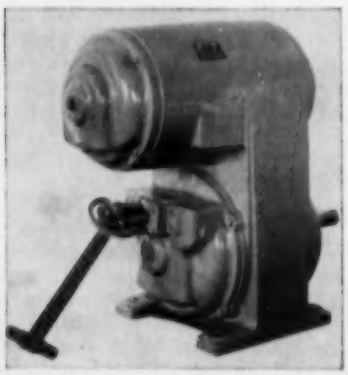
C10 INDUSTRIAL FANS — The new line of industrial type fans announced by Bayley Blower Co. offers designs of higher efficiency, new proportions conforming to latest NAFM standards, and choice of wheel types best adapted to specific applications. With accessories and modifications, these fans are adaptable to almost any type of fume, materials handling, or high-temperature application.



C12 D-C BRAKING controller, no larger than a combination line-starter, is available from Westinghouse Electric Corp. in two sizes of enclosures for braking standard induction motors from ¼ to 25 hp. Operated from a single start-stop pushbutton, the controller requires no adjustment after initial installation. Its main components are a selenium rectifier, contactors, transformer, and a timing circuit.



C14 TORQUE LIMITERS announced by Morse Chain Co. are slip-type friction clutch devices upon which such drive components as standard Type A plain plate roller chain sprockets, special V-belt pulleys, or gears can be mounted. They act as automatic shear pin mechanisms and avoid time and labor required to insert new shear pins. The 11 standard models have capacities from 20 to 620 ft-lb.



C11 MECHANICAL LEVER controls are now available from Sterling Electric Motors, Inc. for use with their Speed-Trol Variable Speed Transmission. Typical applications for this type of direct control include: follower rolls; steam or pneumatic regulators; and steam, pneumatic, or hydraulic cylinders.

C13 TIME DELAY RELAY announced by Automatic Switch Co. will provide any delay from ½ to 6 sec for all standard ac voltages, 60 cycles. It is also available for other frequencies and for d-c. The ASCO Relay handles motor loads directly since the design incorporates a time relay and a contactor.

C15 RELIEF VALVE — Addition of a new ASME rated pressure relief valve with relieving capacity of 750,000 Btu per hr is announced by Bell & Gossett Co. To be known as the ₡750, the valve employs a new type of silicone disc seat which is impervious to excessive temperatures. Literature is available.

NOTE—Each new product item has a key number for your convenience in asking for additional, detailed information. Circle this number on Reply Card, pages 34/35 & 82/83.

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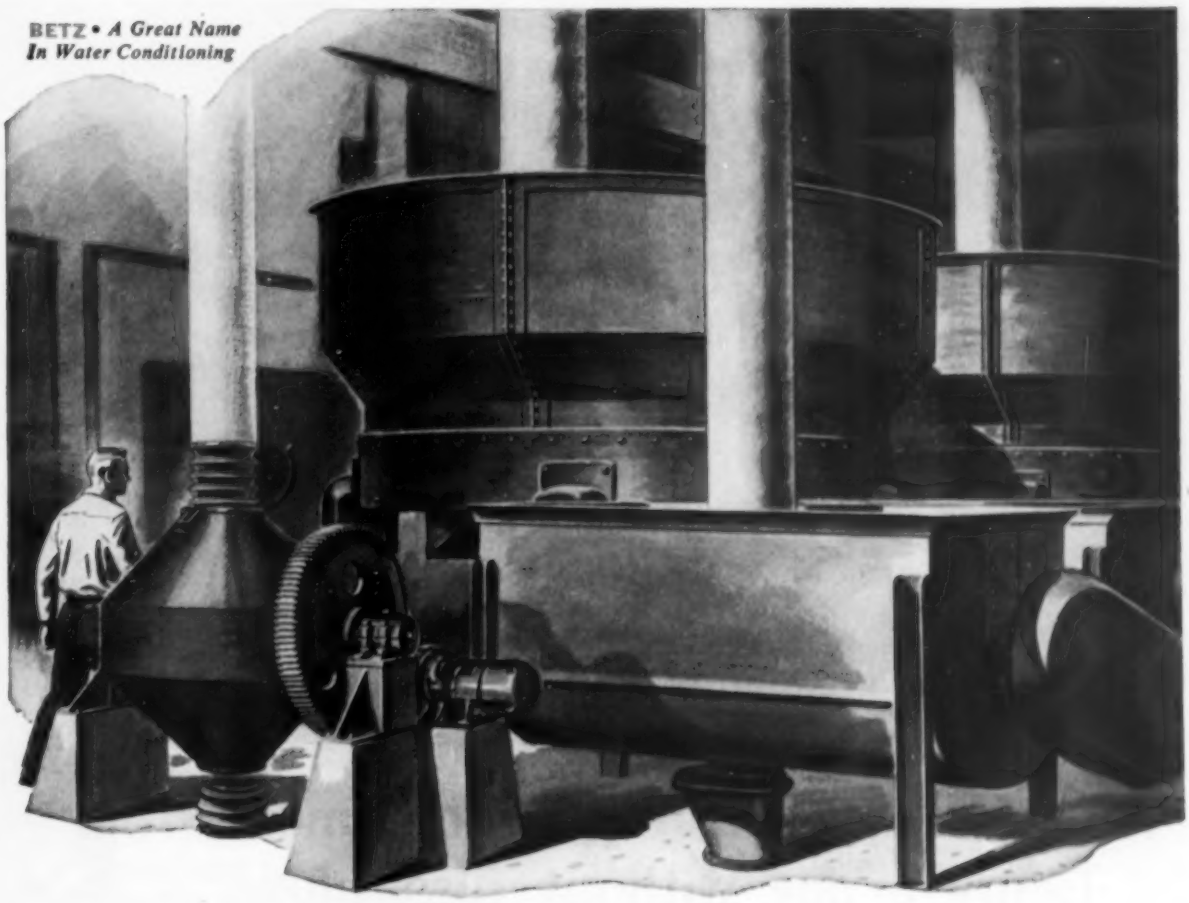
BETZ • *A Great Name In Water Conditioning*



If YOU could step into this picture...

. . . you would find yourself in Philadelphia . . . or Texas . . . or California . . . or Montreal . . . in one of the four Betz strategically-located mixing and formulating plants.

Here you would see a battery of giant mixers, whose fingers of steel effortlessly blend and stir thousands of "prescriptions", each formulated to solve some *individual* water conditioning problem for industry. Perhaps you'd notice a special packaging machine, the extremely accurate weighing apparatus . . . or maybe a ton or two of chemicals neatly stacked, ready for formulating.

A little further along, you'd see row upon row of barrels, drums, and boxes ready for shipment . . . each bearing a different contents label.

Perhaps then you'd feel, as many other visitors have, that this division of the Betz Organization *actually performs the function of a giant pharmacy*—the focal point of Betz engineering skill and experience.

And you would profit by your visit, too, since you'd obtain an idea or two on how your plant could operate more efficiently and economically through the use of Betz *completely-integrated* water conditioning service.

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BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

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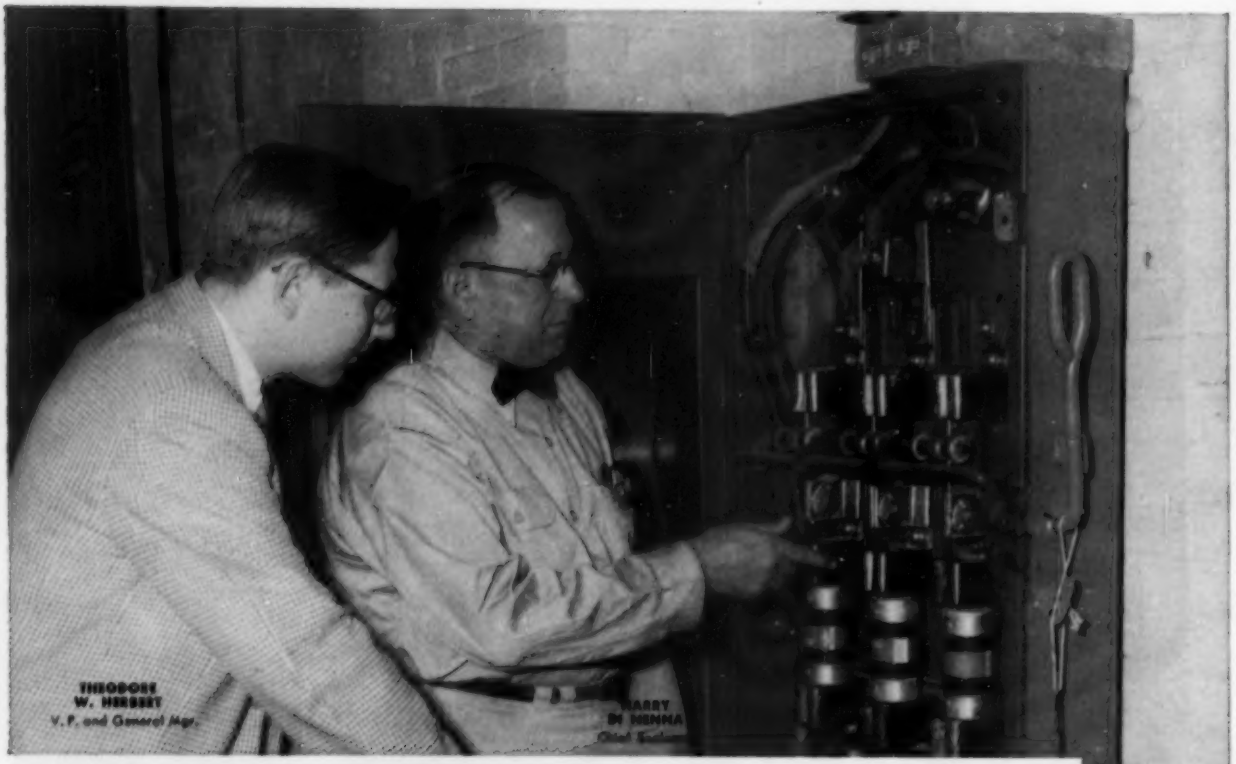


"We can now push our equipment 24 hours a day without fuse blows causing needless shutdowns, thanks to Fusetron *dual-element* Fuses."

"When we are on a tight schedule, we must operate 24 hours a day to fill our orders. Every piece of equipment in the plant is pushed to its limit. A work stoppage of any kind is more than annoying, it is most important as we just can't afford to waste time.

"We were using ordinary fuses to protect our motors, but these fuses couldn't hold up under the pressure. They would blow often and as I now know — needlessly.

"Every time a fuse blew we were losing money. I would start figuring how much harder and faster we would have to work to get back on schedule.

"Something had to be done. We called upon Mr. Paul Serotta of the Norristown Electric Supply Company. He recommended we discard our old fuses and replace them with Fusetron dual-element fuses.

"That was the answer all right. We can really notice the difference. Now, when we are on full production basis I am not worried that our equipment will be out of operation by the needless blowing of fuses."

Harry DiNenna
CHIEF ENGINEER
HERBERT HOSIERY COMPANY
NORRISTOWN, PA.

Play Safe! install Fusetron and BUSS Hi-Cap

Fusetron Fuses Do More Than Eliminate Shutdowns Caused By Needless Blows...

FUSETRON FUSES PROVIDE 10 POINT PROTECTION...

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnouts.

FUSETRON FUSES SAVE YOU Maintenance and Recalibration Costs

Once properly installed, Fusetron fuses require no costly inspection time or maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

When a Fusetron fuse does open to protect, and after the fault has been corrected — the new Fusetron fuse you have installed has been *calibrated at the factory by engineers* — it is a fuse as safe and dependable as the one that blew.

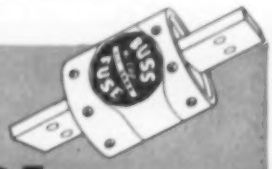
FUSETRON FUSES GIVE YOU GREATER SAFETY, BECAUSE OF THEIR HIGH INTERRUPTING CAPACITY

Tests verified by the Electrical Testing Laboratories of New York indicate that Fusetron fuses can interrupt safely the most severe available short-circuit current.

The tests circuits were set to deliver in excess of 100,000 amps. In each test the fuse cleared the circuit safely, the fuse remained intact, there was very little noise and cotton packed around the fuse was not ignited.

Yet there has been no interference with the time-lag characteristic of Fusetron fuses.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS., BUSS Hi-Cap FUSES PROVIDE...



Unlimited interrupting capacity to handle any fault current regardless of system growth! This was confirmed by tests witnessed and reported upon by the Electrical Testing Laboratories of New York.

Overload protection as well as short-circuit protection.

Coordination with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

On old installations, a safe and relatively inexpensive way to protect inadequate circuit breakers against rupture in event of bad fault.

Dependable service through the years because there are no moving parts to stick or get out of order.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Blowing time charts and more information are available on FUSETRON Fuses and BUSS Hi-Cap fuses. Write for bulletin FIS and HCS.

BUSSMANN MFG. CO., (Division of McGraw Electric Company) University at Jefferson, St. Louis 7, Mo.

Fuses throughout the entire Electrical System!

Circle 507 on Reply Card for more data

new equipment

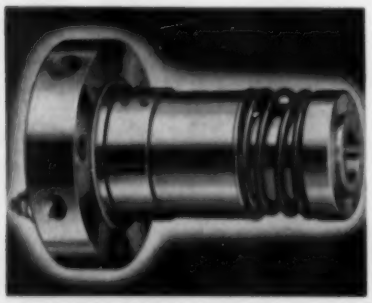
—Starts on page 10

C16 FLOOR RESURFACING material announced by the Monroe Co., Inc. is said to be smoother, easier to apply, and capable of withstanding heavy traffic within one minute after application. Known as Swift-Floor Medium, this plastic flooring is an improved, companion product of regular grade Swift-Floor. It can be applied over wood, concrete, brick, or steel—indoors or out.

TO GET MORE INFORMATION

Circle "key" numbers on Reply Card between pages 34/35 & 82/83. Your requests will be handled promptly.

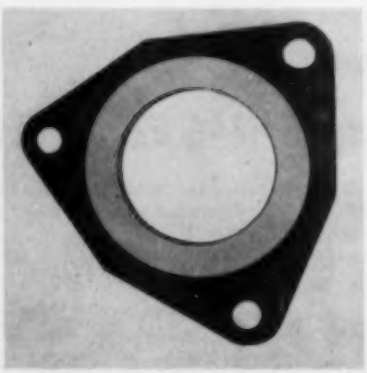
C17 LIQUID CLEANER—Developed by Chemical Cleaning Service Inc. to take the place of toxic cleaning materials, Dynasol is a chlorinated aliphatic hydrocarbon used in cleaning of windings, motors, meters, circuit breakers, and wherever else precision cleaning is required. It is only 1/20 as toxic as carbontetrachloride, is non-flammable, and leaves no residue.



C18 MECHANICAL SEAL—Byron Jackson Co. announces a high temperature mechanical seal designed to handle the requirements of refinery service, including hot asphalt and hot oil pumping up to 800 F. All-metal, the seal has no gaskets other than the shaft sleeve to the shaft and the seal cover to the stuffingbox. It is completely corrosion-resistant and is available in any size and for any pressure encountered in refinery operation.

C19 THE GENERATOR introduced by Master Vibrators Co. is lightweight enough to be carried by one man yet puts out 1500 w of electricity, enough to operate small tools, floodlights, and electric pumps. A four-cycle direct-driven, 3 hp gasoline engine runs the generator. Because of its automatic rewind starter and built-in sockets, it is plugged in and running in seconds.

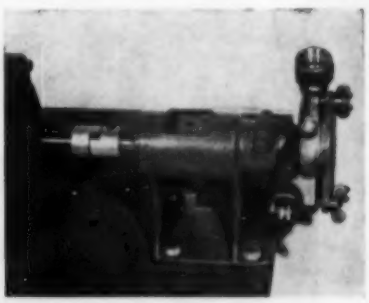
C20 ALUMINUM BUS conductor, RABC, has been developed by Reynolds Metals Co. to answer the need for an aluminum conductor that would replace copper. A typical replacement would be a ¼ by 4 in. aluminum bus for a ¼ by 3 in. copper bus, each having approximately the same current-carrying capacity for a given temperature rise. No change in spacing of supports is necessary and maximum heat dissipation is maintained.



C21 TEFLON GASKETS designed to eliminate flow restriction and turbulence in the line are announced by Crane Packing Co. Known as the FreeFlow, the gaskets are said to be rupture-proof and may be used for practically all known corrosive services from –100 to 482 F.

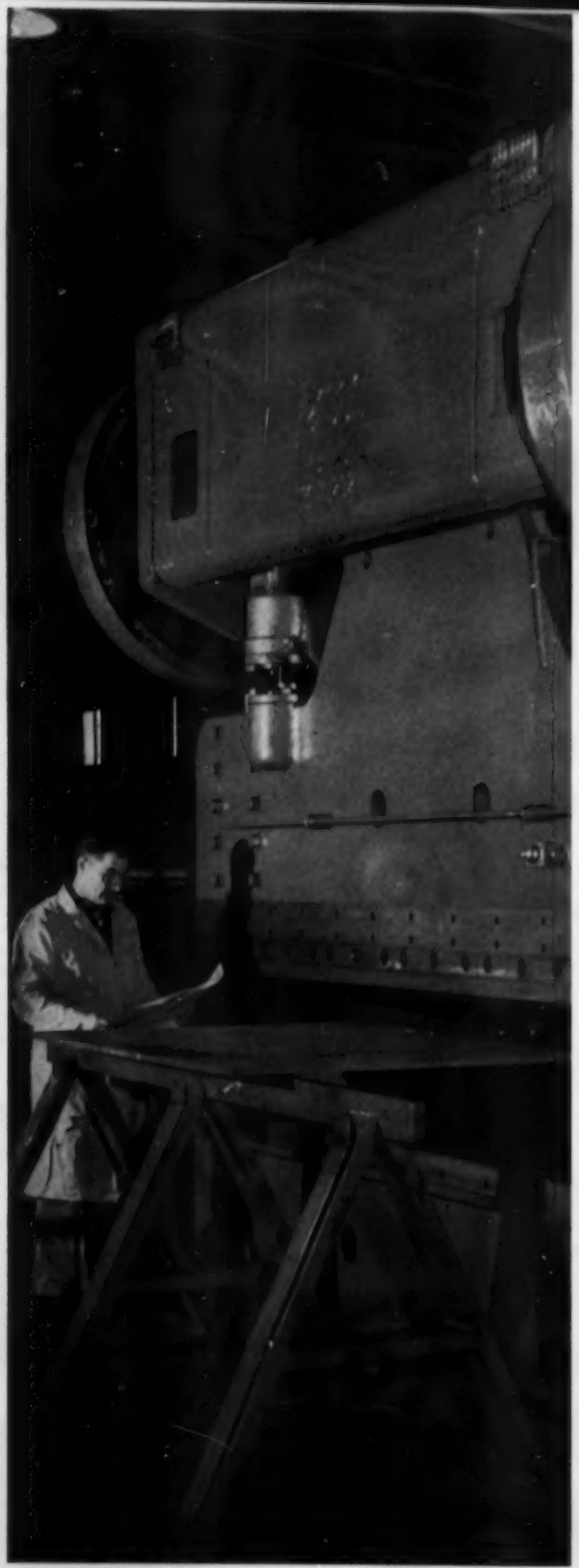
C22 DUST AND FUME collector announced by Van-Truer Co., Inc., is available in a selection of models for a variety of industry-wide applications. The wet-type collector consists of a cylindrical drum with a series of cones and baffles. The fluid feed pump and the exhaust fan are the only moving parts. A dual stage moisture eliminator exhausts dry air.

C23 ROTARY CONVERTER—This series K heavy-duty, industrial-type 3600 rpm converter is used to convert d-c power from either battery or line to a-c. Available from Gothard Manufacturing Co., the converters come in a standard range of frame sizes and in a complete range of electrical ratings. They are available in a number of different models.



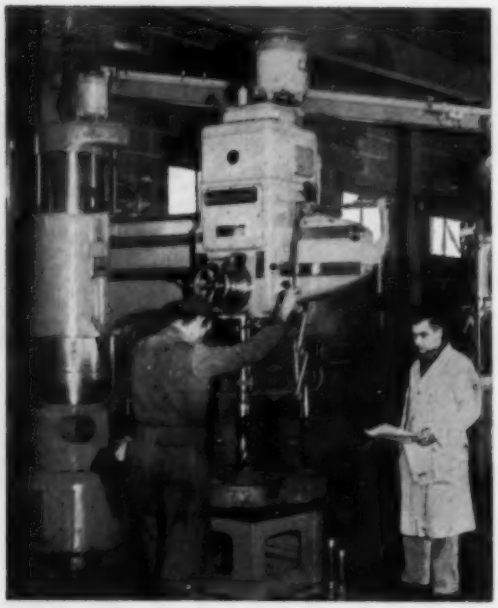
C24 CENTRIFUGAL PUMP—The stainless steel Centri-Chem(R) pump made by ECO Engineering Co. is now available with a pedestal mount designed to permit belt drive or direct coupling with any standard motor. Used for safe handling of materials like anti-biotics, viscous corrosives, hydrogen peroxide, and aromatic solvents, the corrosion resistant monometallic centrifugal pump was previously offered as a close-coupled unit only.

THE VALVE THAT
CONQUERS
FLASHING
CONDENSATES
Better Control, with Lower
Initial and Maintenance Costs
Use Annin valves for better control of steam and condensates to 2500 PSI and 900° F *without* use of hard-to-maintain special assemblies. Flanged seat ring eliminates seal welding. Body construction eliminates liners and reduces down stream piping erosion. Available with manual, cylinder or Domotor automatic operators. Single seat provides bubble-tight shut-off. For better control, longer life, and lower maintenance use ANNIN CONTROL VALVES.
THE ANNIN COMPANY
6570 E. Telegraph Road, Los Angeles 22, California
ANNIN
Control
VALVES
ANNIN
VALVES
WRITE TODAY FOR ILLUSTRATED CATALOG 1500 B
You'll profit by learning more about the superior features and better performance of Annin Control Valves.
Circle 508 on Reply Card for more data



PRESS BRAKE

PRESS BRAKE, 400 Ton capacity, for forming and bending. Also equipped with demountable bed and ram flanges for gang punching or heavy progressive die work.



Our Modern

RADIAL DRILLS

RADIAL DRILLS, for heavy duty, high speed drilling, reaming, tapping, counter boring and similar operations. Automatic clamping of arm on column assures accuracy without expense of jigs.

Heavy Equipment Saves You Money

SQUARING SHEAR

SQUARING SHEAR, ¾"x10' capacity, for accurate blanks. Also equipped with adjustable ram for notching and slitting special shapes of unlimited lengths. Micromatic adjustment screws permit close-tolerance setting of blade to insure true 90° cut.

GEARED HEAD ENGINE LATHE

ENGINE LATHE, 30 inch swing by 25 feet between centers, with two compound tool-rest carriages. Motor-driven taper attachment on each carriage, which allows turning of continuous tapers along entire length of the machine.

designers and fabricators of precision steel weldments

ST. JOSEPH, MICHIGAN

THE foster COMPANY

Circle 509 on Reply Card for more data

MANZEL

FORCE FEED LUBRICATORS COST LESS...

than doing without them!

Pressure Application — Exact Amounts — Accurately Timed

* Manzel Force Feed Lubricators quickly save their cost by preventing breakdowns due to faulty or forgotten lubrication — by reducing the quantity of lubricants used — and by eliminating the labor of hand oiling. They keep vital parts properly lubricated for uninterrupted production efficiency round the clock.

You can have Manzel Force Feed Lubricators installed on present equipment or engineered into new machinery. Write for information.

Manzel

DIVISION OF FRONTIER INDUSTRIES, Inc.
320 BABCOCK STREET, BUFFALO 10, NEW YORK

Circle 510 on Reply Card for more data

new equipment

—Starts on page 10

C25 HEAT EXCHANGER FANS with plastic-impregnated wood blades are announced by Hartzell Propeller Fan Co. The wood blades are available on 14 to 22 ft heat exchanger fans made in the tapered-blade design. Blades are considerably thicker at the shank than at the tip to produce increases in strength and stiffness as well as in over-all efficiency.

C26 RESISTANCE METERS — Designed to measure degrees of insulation resistance, polarization index, and leakage current, the 10 kv meter announced by General Electric Company's Instrument Dept. is portable. It will measure insulation resistances up to 200,000 megohms at 10 kw and when utilized for d-c testing, will reveal faults not observable by a-c tests.

C27 PNEUMATIC RELAYS developed by the Powers Regulator Co. perform such functions as air volume amplifying; pressure reversing, retarding, advancing, and averaging; differential controlling; and minimum pressure controlling. Control in most units is gradual although snap action is available in some of the devices.

C28 CANNED ROTOR PUMPS known as the Model CHS series are now available from Chempump Corp. in 5 and 7½ hp. sizes. These seal-less pumps offer leak-

Circle 525 on Reply Card for more data

PERFECT WATER TREATMENT PERFORMANCE (CONTINUED)

Proof of PERFECT* Water Treatment PERFORMANCE

Nearly 12 billion pounds of steam have been generated inside this boiler and its twin. Boilers have never been acid cleaned. Tubes have never been turbined. All water side surfaces are clean-to-metal.

TURN THE PAGE FOR MORE FACTS ON HOW IT WAS DONE

*We at think at least 99%!

BOILER OPERATING DATA

● Two new boilers were put on line in a Southwestern municipal utility plant at the same time late in 1949. Rated capacity of each unit is 250,000 pounds of steam per hour at 950 p.s.i. Normal operating rates range from 150,000 to 175,000 pounds of steam per hour per unit.

The Nalco System of water treatment has been used continuously in these boilers. Raw water softening is by Nalcite* Ion Exchange Resins, and other Nalco products are used for after-treatment, internal treatment, and condensate return line protection. Results have been perfect. Boilers have never been turbined or acid cleaned, and are opened only for annual internal inspection.

** Registered Trademark*

CLEAN . . . FOR TOP HEAT TRANSFER EFFICIENCY
What appear to be chalk marks in this unretouched photo are scrape marks which indicate only the usual powdery film left on the metal when the boiler is drained.

AND THE MUD DRUM IS SPOTLESS, TOO!
Another unretouched photo inside the mud drum of one of the boilers shows the like-new condition after years of service. No deposits or corrosion of any kind have been found in tubes or drums.

Nalco ON THE JOB

● Results like these are encountered every day in plants when the complete Nalco System of water treatment is on the job. The Nalco System is adaptable to old and new plants of any capacity, temperature, or pressure. Whether you operate a public utility or a space heating boiler, you will find your Nalco Representative of real assistance in the solution of your water treatment problems. Call him today, or write for full information.

NATIONAL ALUMINATE CORPORATION
6216 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*® SYSTEM . . . Serving Industry through Practical Applied Science

proof pumping at heads to 195 ft and capacities to 300 gal per min. Temperature and pressure limits are 450 F and 150 psi with stock models.

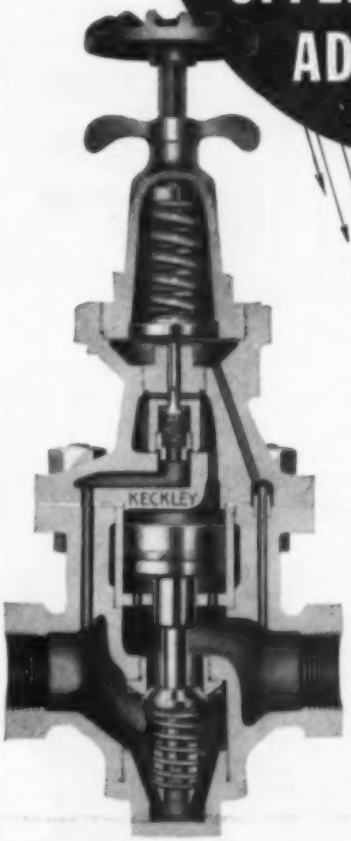
C29 GAS SAMPLING UNIT—The Model Y-101 introduced by Arnold O. Beckman, Inc. provides a compact (9⅜ in. wide, 6 in. high, 12⅝ in. deep, weight 15 lb) system for bringing sample gas streams to an analyzer for measurement. It operates on 115 v ac.

C30 REFRACTORY CASTABLE, Hydrecon 186, extra strength, is intended for use in lining all types of industrial furnaces, boilers, and incinerators where a 2450 F refractory lining is desired with higher compressive strength than that afforded by a regular 2450 F castable. According to J. H. France Refractory Co., the manufacturer, it develops almost twice the cold set strength of 2450 F castables at room temperatures.

C31 TUBING — Corrosion-resistant cold drawn wrought iron tubing for installation in heat transfer apparatus and air conditioning systems is now available from A. M. Byers Co. Physical properties conform to those listed for welded wrought iron pipe in ASTM Specification A-72. Tubing is available in sizes ranging from ⅜ to 3½ in. OD and in 14 to 8 gage thickness.

C32 LIGHT CONTROL known as the Luxtrol controls the light intensity of rapid start fluorescent lamps when used in conjunction with ballasts designed specially for the

ONLY KECKLEY PRESSURE REGULATORS OFFER ALL THESE ADVANTAGES



Type AA Keckley Pressure Regulator

- Tested with steam for dead end service.
- No change of springs for different pressures.
- Stainless steel springs to insure long life.
- Phosphor bronze diaphragm.
- Stainless steel "unit pilot valve."
- Copper asbestos gaskets.
- Piston above flow, operation not affected by sediment.
- Bronze or monel renewable cylinder liner.
- Cast iron piston rings.
- Government bronze castings suitable for high temperatures.
- Stainless steel main valve and seat.
- Renewable features.
- No stuffing boxes, dash pots or weights.
- Guaranteed.
- Order one for test—no obligation.

Tested and approved—U. S. Navy for design · materials · workmanship and operation.

For complete details about all Keckley products, send for Catalog 54-E

O. C. KECKLEY COMPANY
400 W. MADISON ST.
CHICAGO 6, ILLINOIS

Pressure Regulators • Temperature Regulators • Float Valves
Strainers • Solenoid Valves • Reducing Valves
Pop Safety Valves • Relief Valves

KECKLEY CHICAGO

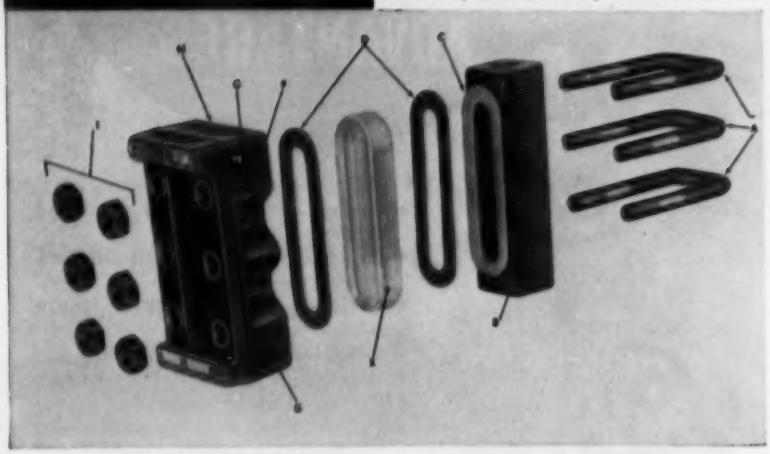
Circle 511 on Reply Card for more data

← Circle 525 on Reply Card for more data

HERE'S WHY
PENBERTHY
REFLEX GAGES
OFFER EXTRA
ADVANTAGES

CLEAR, ACCURATE LIQUID-LEVEL READINGS
In all tanks, boilers, vessels, containers, flow lines.
PENBERTHY REFLEX GAGES TYPE V & S

- **A** Alloy Steel Bolts for high temperature service
- **B** Alloy Steel Liquid Chamber heat treated to prevent warping
- **C** Raised Face on Liquid Chamber insures perfect self-alignment of frame with glass and gasket.
- **D** Special Composition Gaskets and Cushions are interchangeable
- **E** Resilient Band around glass centralizes it at assembly.
- **F** Drop Forged Steel Frame extra heavy and rigid
- **G** Extra heavy beam at end of Frame (prevents distortion when bolts are tightened to meet high pressure service)
- **H** Frame overlaps liquid chamber at all points — provides full backing for the gasket preventing blow-outs
- **I** Alloy Steel accurately threaded nuts



RAISED FACE
IS EXCLUSIVE FEATURE

The construction of a Penberthy Gage invites comparison to prove superiority. Note especially the easy glass or gasket replacement and glass cleaning made possible by the fully accessible RAISED FACE. Perfect alignment of frame with glass and gasket is assured. Gasket surface can be repaired without removing assembly from vessel.

Designed for temperatures ranging from sub-zero to over 1000°F. and for test pressures exceeding 15,000 psi., Penberthy gages are used extensively for liquids ranging from water to highly corrosive and dangerous chemicals.

Available in a wide variety of materials including bronze, iron, carbon steel, stainless, monel, etc.

WRITE for Catalog No. 35. Order through your jobber or direct.

PENBERTHY INJECTOR COMPANY
Division of the Buffalo-Eclipse Corporation
1242 Holden Avenue, Detroit 2, Michigan

There's Certain Satisfaction in
PRODUCTS BY PENBERTHY

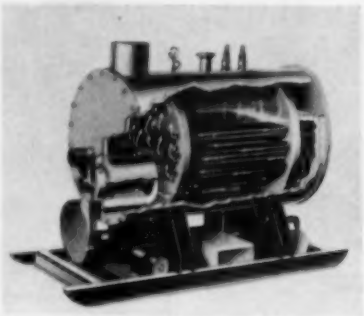
- GAGES
- EJECTORS
- EDUCTORS
- EXHAUSTERS
- SYPHONS
- ELECTRIC SUMP PUMPS
- CYCLING JET PUMPS
- INJECTORS

Circle 512 on Reply Card for more data

new equipment

—Starts on page 10

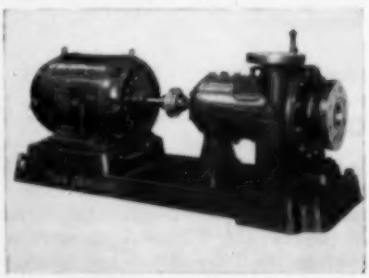
application. Introduced by Superior Electric Co., the control and ballast combination provides better performance without the problems of warm-up time and tube replacement.



C33 COMPACT BOILERS introduced by Brown Fintube Co. employ tubes with internal fins that are said to provide 3 1/3 times greater fire-side to water-side surface ratio that can be obtained with plain bare tubes. Built in standard 30, 60, and 100 hp sizes, the boilers burn either gaseous or liquid fuel.

TO REQUEST FREE BULLETINS

Circle "key" numbers on Reply Card between pages 34/35 & 82/83. Your requests will be handled promptly.



C34 CENTRIFUGAL PUMPS — Interchangeability of parts is a new feature of the completely integrated line of single stage, end suction, centrifugal process pumps announced by Dean Brothers Pumps Inc. For service up to 850 F, three series of pumps are available with capacities from three to 7000 gpm. Three companion series are available for temperatures to 350 F.

Air Casualties

It's bad air that does it. But you can step up production by putting a Coppus Blower on the job to keep the air moving — and keep the men cool.

The kind of air a man works in has a lot to do with how much work he can turn out.

In confined places like shipholds or tanks or drums or boilers . . . or wherever the air is stagnant or hot or full of fumes . . . a Coppus Blower is a *must* for getting first-class work out of the men, all the time.

A Coppus Blower or Exhauster helps avoid sickness and lassitude due to bad air . . . and improves morale, too.

Portable and adaptable for special purposes, Coppus Blowers and Exhausters will have dozens of uses around your plant. The "Blue Ribbon" (a blue painted band) is your assurance of quality performance at lowest cost.

COPPUS

BLUE RIBBON BLOWERS

THE BLOWERS THAT PUT MORE MINUTES IN EVERY MAN-HOUR

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 183 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuselages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

NAME .....

COMPANY .....

ADDRESS .....

CITY .....

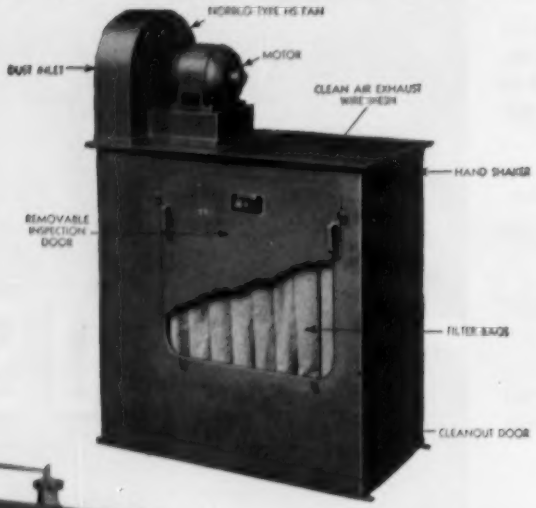
(Write here any special ventilating problem you may have.)

Circle 513 on Reply Card for more data

Protect work and workers–control dust with

Norblo

Portable bag-type Dust Collectors



Many plants can be effectively and profitably equipped with Norblo Portable and Semi-Portable Dust Collection Units, to remove unhealthful and sometimes dangerous contaminants from dust-producing machines. Localized dust control for grinding, polishing, sawing and other operations is thus provided at much lower cost than with a large centralized system.

Norblo Portables occupy small space, can be elevated to save floor area. And they're easily moved if re-location of machines proves desirable. Units are available in various arrangements for dust clean-out. Six sizes range from 300 to 1350 C.F.M., operate at 8" static pressure at the fan. Also larger sizes—semi-portable. Write for Bulletin 163-5.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

6422 Barberton Ave. Olympic 1-1300 Cleveland 2, Ohio

Circle 514 on Reply Card for more data

new equipment

—Starts on page 10

C35 SOLUTION FEED type chlorinators with corrosion-proof polymer-impregnated fiber glass cabinets are announced by Fischer & Porter Co. Six metering tube and float combinations, interchangeable from the front of the cabinet, provide 10 to 1 or greater overlapping flow ranges from a minimum of 100 lb per day to a maximum of 8000 lb per day of chlorine.

TO REQUEST ADDITIONAL DATA

Circle "key" numbers on Reply Card between pages 34/35 & 82/83. Your requests will be handled promptly.

C36 CLOSING DEVICE—A portable packaged power operator for closing oil-less circuit breakers in metal-clad switchgear under actual operating conditions has been introduced by General Electric Company's Medium Voltage Switchgear Dept. Known as the Cooperator, the

Circle 515 on Reply Card for more data ⟶

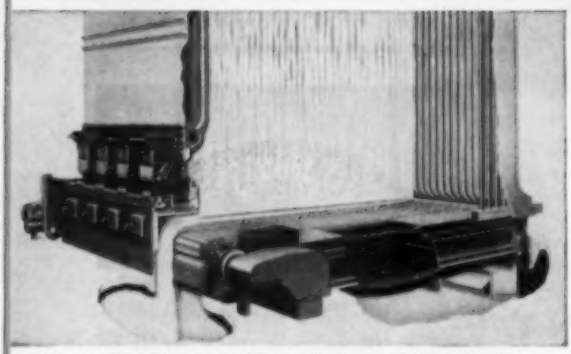
Let's take a NEW LOOK at spreader stoker firing

particularly

DETROIT ROTOGRATE

stoker advantages

One of five Detroit RotoGrate Stokers assembled before shipment to a mid-west public utility.



Detroit RotoGrate Stoker with two of the six Rotors removed to show the overlapping highly restricted grate designed especially for spreader stoker firing.

- **High Burning Rates** per square foot of grate area permit continuous operation with less expensive boiler and furnace design
- **Low Carbon Loss** results in high over-all efficiency
- **Superior Design** permits operation with low excess air
- **Wide Load Range** handled smokelessly with convertible grate area
- **Low Maintenance** compared to other coal-burning methods.
- **Burns All** bituminous coals and Lignite. Also bark, wood, bagasse and other refuse fuels, either separately or in combination with coal

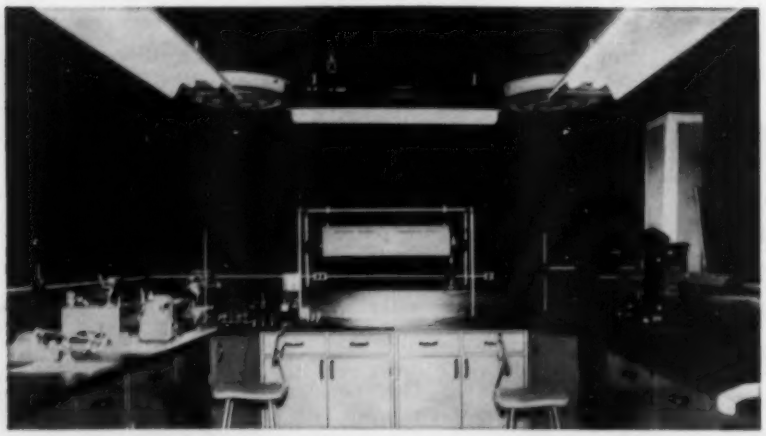
• Contact our nearest District Office or your consulting engineer.

Backed by over a half century of experience. Complete manufacturing and service facilities.

DETROIT STOKER COMPANY

General Motors Building — Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan



You Can Have DRY Air with EXACT Moisture Control

for your comfort, for your process, for testing machines or materials at any time of the year

Niagara Air Conditioning provides you with any temperature and relative humidity you need, held constant or varied at will. Using "Hygrol" absorbent, you save the refrigeration commonly used to condense moisture and make reheat unnecessary in most cases. It gives large capacity with compact, easily-maintained equipment.

This Niagara Air Conditioning Method dries air directly and measurably, using a moisture-absorbing liquid spray. Humidity control is a separate function from heating or cooling.

This gives you precise control over your air conditions with thermostats alone; no moisture-sensitive devices are needed. You have simpler, more trustworthy, less expensive control instrumentation. Niagara precise-control air conditioning installations have the best record for reliability.

Write for information on the application to your problem. Ask for descriptive Bulletins #112 and #121. Address Dept. IP

NIAGARA BLOWER COMPANY

405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Cities of United States and Canada

Circle 516 on Reply Card for more data

new equipment

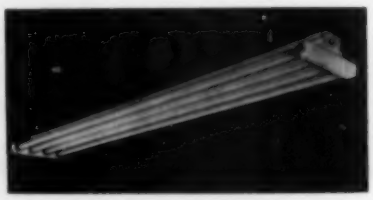
—Starts on page 10

unit operates independently of the regular source of control or closing power in a station. Liquid carbon dioxide is its source of closing power.

C37 EXPANSION JOINTS—Yarway Integral Gland expansion joints are the newest addition to the line of Gun-Pakt joints. Body and gland are of one-piece construction. New plugs of packing are readily inserted without removing either the gland or the old packing. Yarnall-Waring Co., the manufacturer, has designed the joints so that they require no attention except an occasional turn of the packing gun plungers and regular lubrication of the packing.

TO REQUEST ADDITIONAL DATA

Circle "key" numbers on Reply Card between pages 34/35 & 82/83. Your requests will be handled promptly.

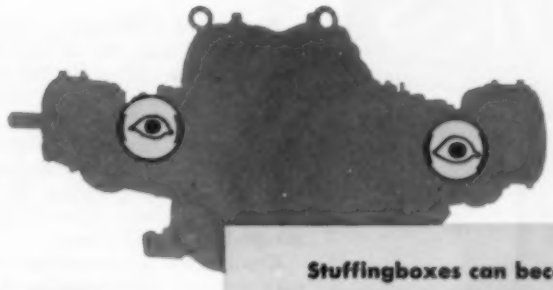


C38 LIGHTING FIXTURES — Designed to be used where quantity of light and economy of installation are major considerations, a new series of multi-purpose large strip fluorescent lighting fixtures known as the Suburban Line are announced by Sylvania Electric Products, Inc. They may be surface-mounted, or pendant-mounted by chain, pipe, or messenger cable.

C39 WIRE ROPE, 15 percent stronger than the best wire rope formerly available, is announced by American Chain & Cable Co. An average tensile strength of 300,000 psi has been achieved by the use of special analysis high carbon steel wire and improved processing. To be known as the VHS, it is now available in ½ to 2 in. diameters.

Complete manufacturing and service facilities. District Offices in Principal Cities • Works at Monroe, Michigan

Watch your pump's Waste line



Stuffingboxes can become profit-gobbling WASTE LINES if you are using old-fashioned packing or inadequate sealing methods . . .

BJ Mechanical Seals

remove the waste and the worry . . . eliminate unnecessary leakage . . . prevent contamination of pumped liquid . . . protect against volatile liquid hazards . . . handle high temperatures . . . do away with repacking expense and repacking downtime losses. Byron Jackson makes a reliable Mechanical Seal for almost every centrifugal pump requirement. ***Byron Jackson Co.,*** *Since 1872.* P.O. Box 2017, Terminal Annex, Los Angeles 54, California, Sales Offices in Principal Cities.

You'll do better with . . .

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Easily...Economically with Subalox

Subalox is a complete paint system, so easy and economical to use that a single coat gives an excellent and lasting job. Can be applied by customary methods, but for most satisfactory application we recommend floor brooms.

Subalox is based on a heavy collodial lead pigment which gives excellent rust protection and limits spattering when applied to wire mesh.

Subalox is available in a variety of colors—the most popular being the metallics used to simulate the appearance of galvanizing. Old fences can be given a "new look" which can be easily maintained with a minimum of time, labor and material cost.

Detailed instructions are contained in "SIMPLIFIED FENCE PAINTING"—yours for the asking.

Subox Inc.

9 Fairmount Plant, Hackensack, N. J.

Circle 518 on Reply Card for more data

letters

. . . from readers

NFPA Interpretation

Sir:

In the Dec. 1954 issue of INDUSTRY AND POWER, page 86, is the NFPA official interpretation No. 406 of Sections 4409 and 4402 of the 1953 National Electrical Code, relative to the disconnecting means for motors exceeding 50 hp. The interpretation clearly states what cannot be done, but nothing about what would be acceptable in such a case.

Kindly give me, or advise where I may get, an interpretation on the following installation:

A 60 hp motor over 50 ft from a magnetic combination starter controlled by a "start-stop" push button station located at the motor.

Question: May the push button station with locking means on the "stop" button be considered as the disconnecting means required by Section 4402 of the National Electrical Code?

James L. Rorer
Central Engineering
Foote Mineral Co.
Philadelphia, Pa.

—The function of the disconnecting means, as required by NEC, is to isolate the motor and its controller from the source of power. A push-button station would ordinarily not do this, and so could not be considered as a disconnecting means. For an official interpretation write to the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.—Ed.

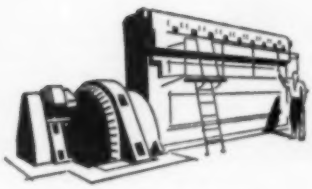
Magnetic Amplifiers

Dear Sir:

Referring to Mr. S. D. Ross' article, Nov. issue, on page 72 ("Electric or Pneumatic Controls"), a magnetic amplifier could be used with its control coil sensitive to variations of power, pressure, temperature, etc. A very small variation in the control coil can cause a wide change in the delivered electric power without using any other amplifying means. The auxiliary pneumatic power system will not be required.

Magnetic amplifiers have a wide industrial use. They are replacing "Electronic Tubes" and finding a large use in motor control.

Henry D. James
Consulting Engineer
Pittsburgh, Pa.



"Cured... bearing failure in their diesel-driven, front-end loaders"

A large fire-brick manufacturing company in the Philadelphia area had the problem of premature bearing failure in its diesel-driven loaders and shovel.

Headlights on even in daylight...

Sinclair Lubrication Engineer Harry Donovan reports, "These units were operating around the clock under conditions *so dusty that headlights were required.* Crankcases had to be drained and flushed bi-weekly! My first recommendation was closer adherence to an air filter maintenance program."

Drain intervals doubled!

Mr. Donovan continues, "Further observation proved to me that excessive idling and overloading were all contributing factors to a severe sludge condition. I recommended Sinclair SUPER TENOL® – explaining that the superior quality of the base oil plus the Sinclair formulated additives would extend bearing life *while at the same time removing accumulated lacquer and sludge.* A trial period proved SUPER TENOL doubled drain intervals and eliminated flushing entirely. This company now uses Sinclair SUPER TENOL exclusively."

Why not give a Sinclair Lubrication Engineer the chance to solve *your* lubrication problems? *There's no obligation.* Contact your local Sinclair office or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR LUBRICANTS

Circle 519 on Reply Card for more data

new bulletins

. . . catalogs from leading manufacturers

200—Valve Selection

Valve users can easily obtain data on valves for a wide variety of applications by using the simplified cross index in 27-page catalog 106. The most widely used cast and forged steel Edward globe and angle stop, non-return, check, gate, hydraulic, relief, mudline, flow-off, instrument valves, and strainers are included. Edward Valves, Inc.

201—Overhead Cranes

"How to Select an Overhead Crane," seven-page bulletin 79, is designed to help those who select and specify cranes to analyze handling problems, decide on type of crane desired, and draw up specification sheets for crane proposals. The Whiting Corp.

202—Smoke Control

Ess "Electric Eye" smoke and combustion instruments for detection and control of smoke and haze are described in eight-page bulletin 532. Two types of recorders for keeping records of smoke or combustion haze densities are shown along with indicators and controls for monitoring or controlling fuel-air ratio for best efficiency. Ess Instrument Co.

203—Cooling Tower Water

"L&N pH Control of Cooling Tower Water," four-page data sheet 700 (1), offers suggestions on measurement and control of pH of cooling tower water, and describes equipment for this application. How pH control can conserve makeup water, protect wood, prevent scale, and minimize slime is explained. Leeds & Northrup Co.

204—Bronze Rotary Pumps

Bulletin W-484-B2B, four pages, provides information on the diversified applications for bronze rotary pumps with herringbone gears. Performance chart provides information on speed, capacity, pressure, and power requirements of various pump sizes. Worthington Corp.

205—Steam Condensers

"Steam Condensers," 23-pages, shows installation pictures of condensers of all types along with sections on engineering, air removal equipment, and maintenance. Sample problems illustrate use of charts and tables in the booklet. Condenser Service & Engineering Co., Inc.

206—Boiler Refractories

"Boiler Refractories," 20-page bulletin R-30, has been designed to provide operators of stationery and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers. A separate section is devoted to ashpit refractories. Babcock & Wilcox Co., Refractories Div.

207—Foamglas Construction

"Foamglas in Thin Wall and Sandwich Panel Construction," 11-page booklet FB-103, explains what Foamglas is and how its special properties make it lightweight, easy to handle, strong, and an ideal insulation material. Many installation photographs are used to show how the material, available in many sizes and thicknesses, can be used for various types of construction. Pittsburgh Corning Corp.

208—Motor Lubrication

"Lubrication of Electric Motors: Ball and Roller Bearing Type," four-page bulletin 504, fully describes proper methods for lubricating and cleaning ball and roller bearings on electric motors. It also includes valuable information explaining how to prolong the life of bearings. New York & New Jersey Lubricant Co.

209—Relays and Pilot Valves

Two-page leaflet 389 describes pneumatic relays and pilot valves, pressure-electric switches, and electric pneumatic valves. Included are gradual direct acting relays, gradual reverse acting relays, and gradual retarded, advanced, and minimum pressure relays, and other related equipment. The Powers Regulator Co.

210—Steel Shelving

Photographs, cartoons, and text are used to point out the features of the new Halloweil Adjustable Steel Shelving in four-page folder 2057. The open and closed type, the ledge type, and various combinations of swinging and sliding doors are featured. Standard Pressed Steel Co.

211—Reuseable Couplings

Bulletin H-100, 11 pages, points out the advantages of using Surgeprof reuseable hose couplings. Assembly instructions are included for either single wire or double wire braid hose along with tables of dimensions and engineering data. Joy Manufacturing Co.

212—Industrial Motors

The principal types of U. S. motors are presented in seven-page booklet 1878. Cut-open views of Varidrive and Syncrogear types are shown in full color. Interesting details on Lubriflush transverse bearing lubrication, asbestos-protected windings, and normalized motor castings are included. U. S. Electrical Motors, Inc.

213—Dust Collectors

This 28-page brochure includes a complete discussion of two types of dust collectors: the Aerodyne and the Paraclone. The Aerodyne is for use in operations where air or gas is to be cleaned either for recovery of useful substances or for elimination of dust and flyash in industrial processes. The Paraclone is for cleaning of flue gas and can be used either alone or in combination with electrostatic collectors. Aerodyne Development Corp.

214—Tile Storage Bins

"Vitrified Glazed Tile Industrial Storage Bins," four-page bulletin 1153-B, tells you how this type of bin can keep materials clean, dry, and ready for use. Drawings show how the tiles are constructed and the simplicity of erecting silos made of these tiles. Kalamazoo Tank and Silo Co.

215—Grating and Stair Treads

Grating and Stair Treads — Bulletin 1105, 16 pages, explains important construction features of Tri-Lox interlocked and Tri-Forged welded grating and stair treads. Photographs and detail sketches illustrate styles available and show typical installations. Dravo Corp.

216—Specifying Relays

"Relay Selection Tabulations," two-page bulletin 553, includes easy-to-read charts of help in specifying magnetically or mechanically held relays. Circuit diagrams are given for both types of relays. Automatic Switch Co.

217—Dealkalizing Equipment

Dealkalizing Salt Splitter — Bulletin 4567 discusses the process of chloride anion exchange, why it is necessary to dealkalize water for boilerfeed and for processing, and shows how water can be dealkalized efficiently and economically with this company's equipment. Cochrane Corp.

218—V-Belt Rating

Multi-V-Drives — This 100-page master engineering manual presents a scientific and simplified method for rating V-Belts. In addition to accepted theories on V-drive engineering, factors such as small diameter sheaves, centrifugal force, average hours per day operation, and other conditions effecting belt lines have been considered. Worthington Corp.

219—Centrifugal Pumps

Eight-page bulletin 105-B describes Aurora Type O horizontal split case, double suction centrifugal pumps which are recommended for municipal and industrial water supply or for handling circulating and wash water, chemical solutions, and oils. Aurora Pump Div., New York Air Brake Co.

220—Water Treatment

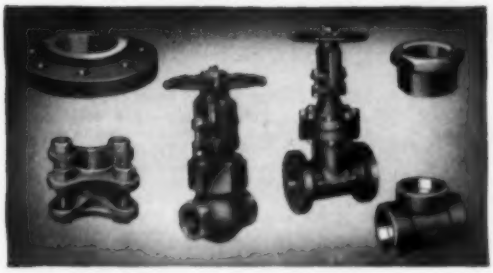
"No. 40 Series Supplementary Treatments," three-page booklet 28X8226, discusses supplementary treatments for boiler makeup water such as treatments for softening traces of hardness, dispersives for conditioning of sludge, oxygen scavengers, and anti-foam agents. Allis-Chalmers Manufacturing Co.

221—Check Valves

Eight-page bulletin W-10 will be a valuable aid to all who are responsible for check valve specification and operation. It includes dimensions, cross-sectional views

NOTE — Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Circle key numbers on Reply Card between pages 34/35 & 82/83.

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.

SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.

Vogt

PRODUCTS

FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland St. Louis, Dallas, Charleston, W. Va.

MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

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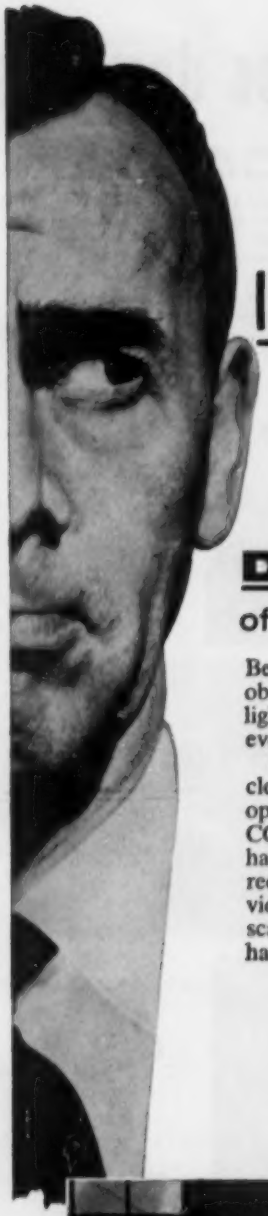


don't be HALF INFORMED

get a **DEMONSTRATION** of the **Airetool CC-4325**

Become acquainted with the remarkable results obtainable from this condenser cleaner . . . it's the lightest, most flexible and mobile condenser cleaner ever offered on the market!

Say goodbye to bulky, cumbersome condenser cleaning equipment . . . gain new speed in your operations with the feather-light new AIRETOOL CC-4325. It weighs only 11 lbs. and is easily handheld by one man, with no supporting rig required! A high-speed two-stage air motor provides extra power to rapidly and completely clean scaled tubes, even those completely plugged with hardest deposits.

The AIRETOOL No. CC-4325 Condenser Cleaner, and a carbide-tipped drill, form a combination that is really speedy and efficient. The built-in hand-controlled flushing system removes chips from the drill point as you work. A wide variety of drill and brush heads are available to meet every condenser cleaning need . . . they're quicker, safer and thorough in cleaning condenser tubes.

WRITE TODAY for complete details about the CC-4325 and other AIRETOOL Tube Cleaning and Expanding Equipment. Ask for your demonstration appointment!

Remember . . . there's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

REPRESENTATIVES in principal cities of U.S.A., Canada, Mexico, South America, England, Japan
BRANCH OFFICES: New York, Chicago Philadelphia, Tulsa, Houston, Baton Rouge

Circle 521 on Reply Card for more data

new bulletins

—Starts on page 28

with parts lists and suggested wiring diagrams. Golden-Anderson Valve Specialty Co.

222—Cooling Tower Fans

Complete details on cooling tower and heat exchanger fans are included in seven-page bulletin A-111A. Featured are specifications and construction details on the new tapered-blade design fans and the plastic-impregnated wood blades for fans in 14 to 22 ft dia sizes. Hartzell Propeller Fan Co.

223—Ball Float Traps

Ball float traps for draining water from air, gas, or steam lines or for draining light liquids from gas under pressure are described in eight-page bulletin 280. An orifice capacity chart and tables of maximum operating pressures enable you to select traps from bulletin. Armstrong Machine Works.

Fuel Cost Calculator

Handy pocket size "slide-rule" fuel cost calculator shows comparative fuel cost of coal, gas, and oil. It is designed so you can quickly and accurately determine your yearly fuel savings when replacing present heating equipment with a Hev-E-Oil burner. Please send requests on company stationery directly to: Cleaver-Brooks Co., Hev-E-Oil Burner Div., Dept. IP, 326 E. Keefe Ave., Milwaukee, Wis. with 25c.

224—Roof Drains

Prepared to aid in specification and installation of roof drains, 47-page "Zurn Roof Drain Manual" 54-1 includes engineering drawings showing types of drains to use for specific application. How to install drains in standard open deck parking areas and outdoor recreation terraces is also shown. J. A. Zurn Mfg. Co.

225—Electrical Connectors

"How to Select and Use Today's Electrical Connectors," nine-page Technical News Letter 24, contains two articles on design of electrical connectors and their efficient application in modernizing industrial plants' electrical distribution systems. Burndy Engineering Co., Inc.

226—Power Station Piping

"For the Modern Central Power Station," 11-page bulletin, describes in some detail the specific services and facilities that Kellogg brings to the utility power piping field. It includes a picture story with text of the development of KW Weld, the technique which assures penetration without use of backing rings. Fabricated Products Div., M. W. Kellogg Co.

227—Centrifugal Pumps

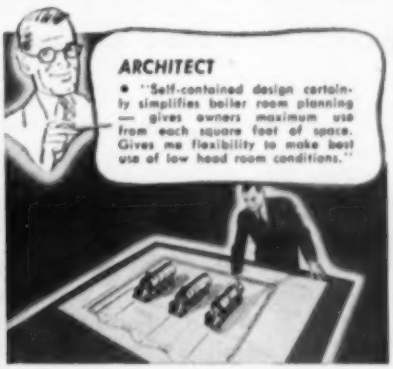
Specifications, materials of construction, and mechanical details of two-stage centrifugal pumps with horizontally split case and opposed impellers are presented in 12-page bulletin 722.6. Goulds Pumps, Inc.

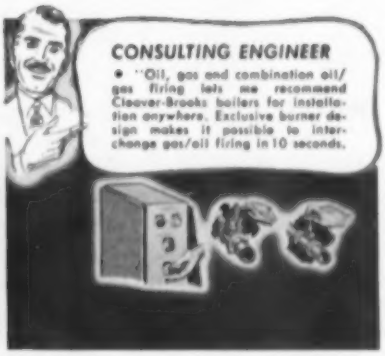
(Continued on page 83)

CLEAVER-BROOKS SELF-CONTAINED BOILERS HAVE THE FEATURES EVERYONE WANTS!

...which feature would be most important to you?

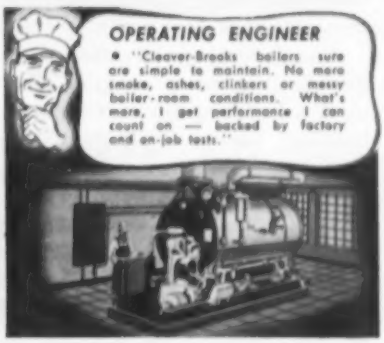
PLANT OWNER
• "Cleaver-Brooks boilers are tops in fuel economy! Forced-draft, four-pass construction and 5 sq. ft. of heating surface per boiler H.P. assure me 80% operating efficiency when firing with oil."

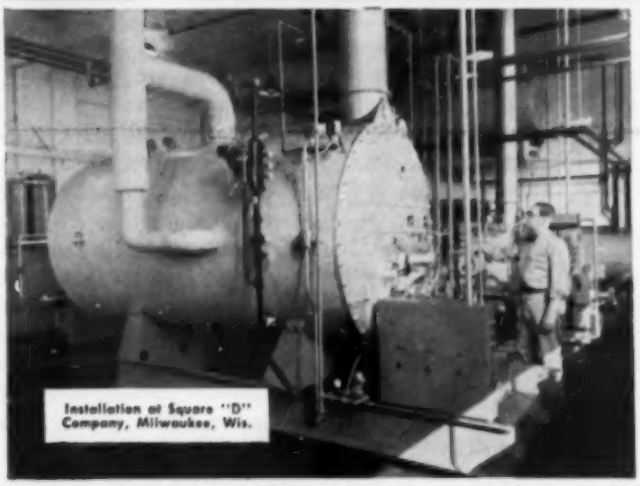

ARCHITECT
• "Self-contained design certainly simplifies boiler room planning — gives owners maximum use from each square foot of space. Gives me flexibility to make best use of low head room conditions."


CONSULTING ENGINEER
• "Oil, gas and combination oil/gas firing lets me recommend Cleaver-Brooks boilers for installation anywhere. Exclusive burner design makes it possible to interchange gas/oil firing in 10 seconds."

CONTRACTOR
• "Boilers are shipped ready to install. With service lines in, my crews have boilers ready for operation in 24 hours or less after delivery. No foundation or stack problems. Cleaver-Brooks furnishes starting service, too."

PLANT SUPERINTENDENT
• "I get all the steam I need for fluctuating steam demands, from full load down to 30% of rating. Automatic burner controls assure instant firing. I call that real dependability."


OPERATING ENGINEER
• "Cleaver-Brooks boilers sure are simple to maintain. No more smoke, ashes, clinkers or messy boiler-room conditions. What's more, I get performance I can count on — backed by factory and on-job tests."



THESE are just a few of the many outstanding features that have made more than 15,000 individual Cleaver-Brooks self-contained boilers *first choice* for commercial, institutional and industrial applications. Get in touch with your nearest Cleaver-Brooks representative for complete facts, or write for catalog AD-100. Cleaver-Brooks Co., Dept. C, 303 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. — *Cable address: CLEBRO — Milwaukee — all codes.*

Cleaver Brooks

"It's NEW — get the facts on the CB boiler — write today!"

BOILERS — STEAM OR HOT WATER — FOR HEATING OR PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI.

NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.

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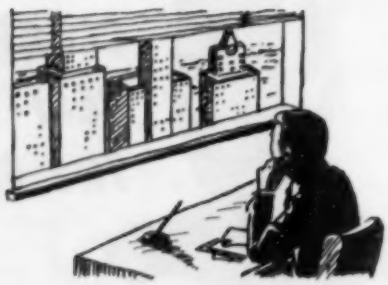
Out Our Window



A Trend Toward Plant Air Conditioning

NO ONE CAN DENY that there is a trend toward more general use of air-conditioning in industrial plants. In some instances this trend is the result of increased efforts toward product quality control. In other instances it is pure and simple consideration for the working conditions of the employees in the plant. Regardless of the cause, the trend is a strong one, and it is proving to be a money saver for those plants that are able to install air-conditioning systems without too much investment in redesign of buildings.

A company now located in a very old building may be in a more fortunate position than the firm with a building ten to twenty years old. The old building has probably been written off by this time, and complete modernization of the building, or new quarters, probably can be justified for reasons other than air-conditioning. If this is the situation, an air-conditioning system can be considered simply as a part of the building program.

On the other hand, a plant building just ten or twenty years old can scarcely be tossed aside like an old shoe. However, the building may be entirely unsuited to economical operation of an air-conditioning system without major and perhaps expensive changes in building design. The walls and roof may be relatively uninsulated. There may be whole sides made up principally of windows—and roofs may be bristling with skylights. Heat gained through these areas is not only excessive but variable.

Such a situation, while regrettable, must be faced squarely. There is no sense in trying to air-condition a "barn" — even a relatively modern "barn." Window areas will have to be bricked up with either glass block or conventional building brick. Roofs will have to be insulated, and major heat leaks will have to be plugged before an air-conditioning system can even be considered seriously.

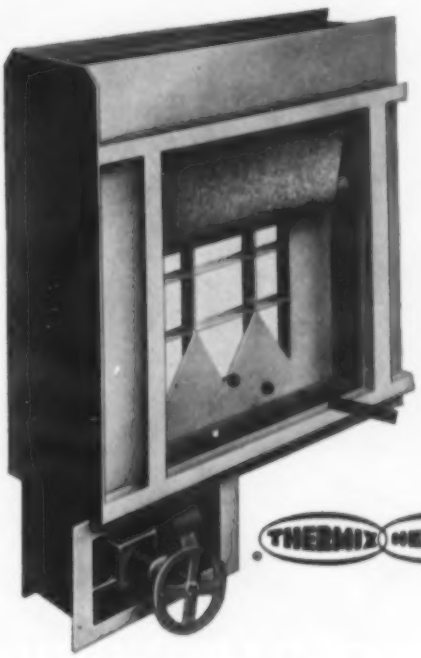
Whether air-conditioning is worth it, when all of these costs that go beyond the cost of the air-conditioning system itself are considered, is a question that must be answered by each plant's own management and engineering group. It is a hard decision to make. While it is easy to get a reasonably accurate estimate of the costs for the whole job, it is very difficult to estimate the returns. How much more output can be expected from employees during hot summer months? How much will the quality of the product be improved? How much can the price of the product be increased as a result of improved quality? Is the purchaser even interested in a better quality product?

One of the ways of looking at this problem of plant air-conditioning was clearly expressed by a consulting engineer in the Southwest, who has supervised installation of many an industrial air-conditioning system in the past few years. He points out that office air-conditioning is so common today that salesmen in the waiting room complain loudly if the area is not pleasantly cool. But does this office air-conditioning make sense? Forgetting the president of the company and his immediate assistants, just who is working in these offices? It is a group of $200 to $300 a month stenographers, file clerks, and bookkeepers. These are the people, presumably, for whom air-conditioning is believed necessary so they can work at their top efficiency.

Take a look back of the office. In the plant there are hundreds of $2.50 to $3.50 an hour men working at much more physically demanding jobs in 90 to 100 degree temperatures. The consulting engineer asks, "Does this make sense?" Would not the savings be much greater if these men in the plant were given the better working conditions rather than the stenographers and file clerks? True, it cost a lot more to air-condition the large plant area than the small office, but if management can justify the expense of air-conditioning the office, surely they can justify the cost for the plant.

While this is an oversimplification of the problem, this consultant has been given a lot of industrial air-conditioning business by elaborating on this theme.

Only a Heacon Damper offers you this



"V" The V that gives you accurate control in the lower flow increments

Heacon Dampers provide the only solution to accurate flow control. With a background of over a decade of application to specialized problems, Heacon Dampers are accepted by engineers as the only means of accurate flow control, particularly in the lower flow increments.

V-porting is the secret. Heacon Dampers may be designed with V-porting to produce practically any flow characteristic from zero to 100%. With conventional dampers barely cracked, a flow of 10 to 20% or more is immediately released with resultant flow control problems in the entire system.

Heacon Dampers are a radical departure from normal damper construction. Consisting of supporting grill, sealing strip and flexible curtain of woven blue asbestos, metal or other suitable material as determined by the application, Heacon Dampers are recommended for use where these two factors, among others, are of major importance:

1.—Accurate control and ease of operation by either manual or mechanical means.

2.—Positive, tight seal when damper is closed.

The Thermix Corp., Project Engineers for Heacon Dampers are specialists in the application of this damper to your particular requirements. Why not call their engineers today.

Project Engineers

THE THERMIX CORPORATION
GREENWICH, CONN.

(OFFICES IN 38 PRINCIPAL CITIES)

Canadian Affiliates: T. C. Chown, Ltd. 1440 St. Catherine St. W., Montreal 25, Quebec. 983 Bay St., Toronto 5, Ontario, Canada

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• Some of the 189 YARWAY Gun-Pakt expansion joints installed at large oil refinery in Texas.

No fatigue with 189 YARWAY GUN-PAKT EXPANSION JOINTS at this large Texas refinery

THEY just work and work for years and never get tired. Yarway Gun-Pakt slip-type joints simply will not fail through fatigue. They will operate smoothly, as frequently as required, over long, full traverse up to 12" single type or 24" double type or short, partial traverse, day in and day out—with never any danger of metal fatigue or failure.

This is just one of the many big advantages found in Yarway Gun-Pakt expansion joints. Other outstanding Gun-Pakt features are:

1. Can be serviced under *full* steam pressure day and night, thus avoiding costly and inconvenient shutdowns.
2. Fixed Gun-Pakt gland serves as "built in" external guide and permits less costly and rigid pipe guidance than required by many other types of joints.
3. Lower pressure load on end anchors because excessive strains are eliminated.

Used for many years with success in well-known refineries, industrial plants, utilities and institutions. When replacing present joints or planning new steam lines, it will pay you to look into the advantages of the Yarway Gun-Pakt expansion joint. Write for Yarway Bulletin EJ-1913.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Phila. 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

gun-pakt expansion joints

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Industry and I&P Power

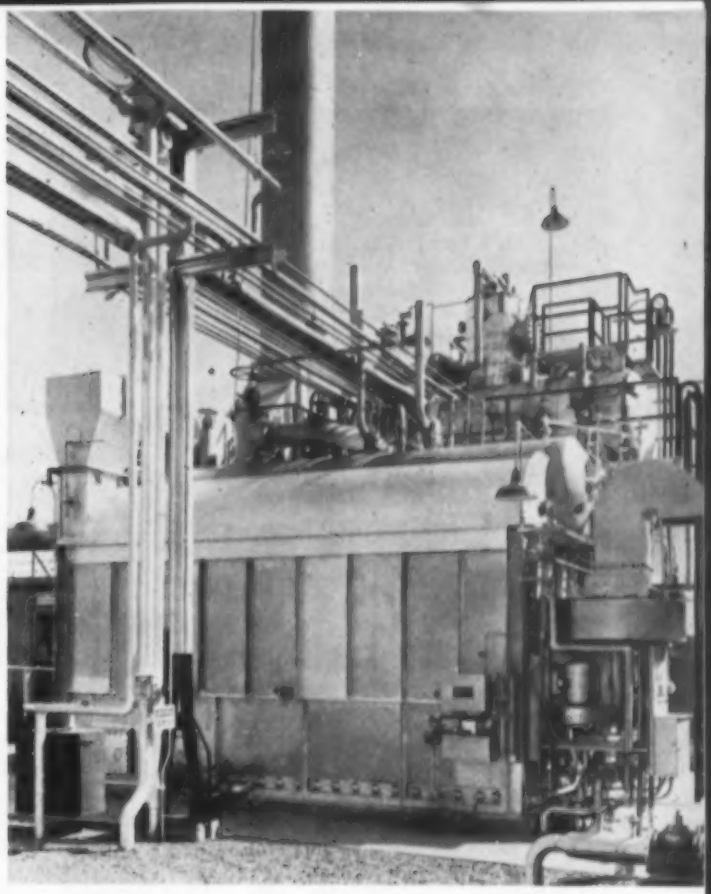

Fig. 1—Installation photo, right, shows the arrangement of the Erie City packaged steam generator with Coen combination gas and oil firing assembly and controls.

TEMPLE S. VOORHEIS
Chief Engineer
Coen Company

Shell Selects Package Boiler For Outdoor Operation

I&P EXCLUSIVE

DURING THE SUMMER and fall of 1953, the plant engineering group, under the direction of R. L. Iglehart, Chief Engineer of Shell Development's laboratories and pilot plants in Emeryville, California, were faced with some unusual problems in selecting a new boiler for their expanding plant. Project conditions indicated an outdoor installation was desirable, yet the available location was near a hazardous area where heavier-than-air combustibles might possibly collect near the ground. This site also was remote from the existing boiler and control building, which contained the fuel oil pumping and heating auxiliaries that would serve the new boiler. In addition, although the unit initially would supply steam at 150-psig pressure, the entire system had to be designed for future 300-psig service.

Study of these various factors showed that a packaged or shop assembled boiler would provide many advantages including: small space requirement, ease of installation, adaptability to outdoor service, favorable initial cost, low maintenance, and simplified operation with single burner and single fan (pressure firing) and coordinated safety and combustion controls.

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Boiler

The boiler selected by Shell Development's engineers, to meet requirements of their installation, is shown above in Fig. 1. This boiler is a packaged, two drum, water tube unit, with 10 ft 4 in. long by 7 ft 3 in. wide (inside tubes) furnace ahead of the convection section. All boiler tubes are 2½-in. OD, and both the steam and lower drums are 34-in. ID. The entire furnace is water cooled including the front wall and floor. Design pressure is 325 psig. The unit contains 2220 sq ft of heating surface and has furnace volume of 640 cu ft. Two furnace observation ports are installed in each side wall at about the height comparable to the centerline of the burner, and the two outlet breeching connections are equipped with uptake dampers. A self-supporting steel stack also was supplied with the boiler of sufficient size (4-ft diameter) for a future boiler and height (75 ft) to clear downwind structures at the plant.

This boiler unit was shop assembled and shipped on its integral subbase with a pressure tight steel casing in place over the insulated setting. The burner throat tiles were added in the field at the time the

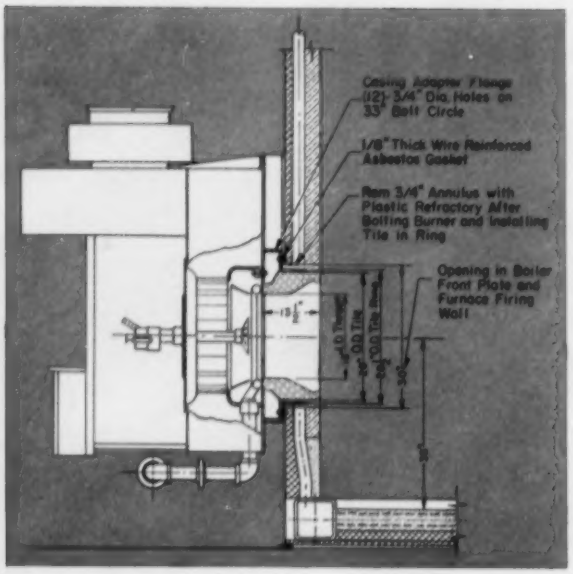
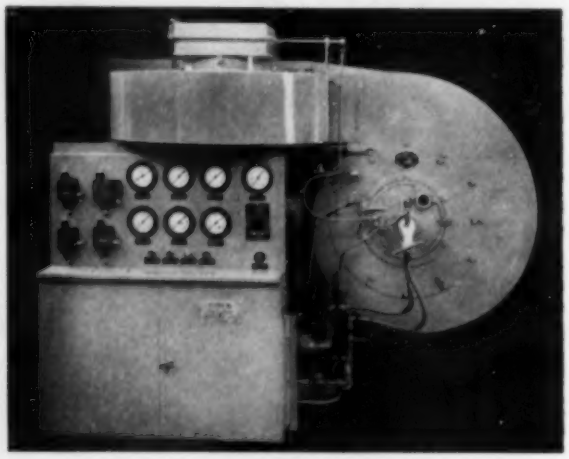

Casing Adapter Flange (12)-3/4" Dia. Holes on 33" Bolt Circle
1/8" Thick Wire Reinforced Asbestos Gasket
Ram 3/4" Annulus with Plastic Refractory After Bolting Burner and Installing Tile in Ring
Opening in Boiler Front Plate and Furnace Firing Wall

Fig. 2—Left. Side sectional elevation of burner and firing wall.

Fig. 3—Below. Burner assembly & combustion control system.



packaged burner was installed on the boiler front. This required only the laying up of 18 pieces of circular, precut, preformed tile into a 28-in. ID steel support ring integral with the burner windbox, and the tamping in place of plastic refractory into the 1-in. annulus between the 28-in. OD tile and a 30-in. ID opening provided in the front wall (see Fig. 2).

Internal distributing pipes also were included with the boiler to permit direct chemical injection because new supplementary water treatment facilities were installed. This system provides sulfide treatment for residual O_2 control and phosphate treatment for inhibiting hard scale formation. All makeup water—approximately 65 percent of the feed—is sodium zeolite treated.

Design Features

Special features also were incorporated with the packaged firing system to meet the requirements peculiar to this installation.

¶ Weatherproofing (insofar as practicable for the San Francisco bay area) was included.

¶ A pressure tight burner, windbox, and fan were selected because of the proximity to a hazardous area. Gasketing, shaft seals, and stuffing boxes virtually eliminate any leakage from (in the event of flareback), or into, the burner windbox and fan housings. In addition, the forced draft fan was arranged to take suction 9 ft above ground level.

¶ Remote control of firing rate from the power house was desired for use during base load operation of the boiler. Thus, an electric linear actuator was supplied. Through a quick disconnect from the automatic control at the boiler, operation of this unit remotely from the power house is provided, permitting manual increase or decrease in firing rate from that point.

Firing Assembly

Construction details of the fan-windbox-burner assembly with boiler mounted control center are shown in Fig. 3). This completely integrated unit was fastened to application bolting provided on the boiler front, using a circular reinforced asbestos gasket around the burner opening to ensure pressure tightness. The fan scroll is mounted horizontally (wheel shaft vertical), and the fan discharges directly into a scroll type of windbox. For this vertical shaft arrangement, a standard pedestal fan is modified by pinning the wheel hub to the shaft and an inserted collar against the inner race of the outer bearing. The fan wheel is a backwardly curved type impeller with nonoverloading power characteristics, V-belt driven at 1326 rpm by a 7½-hp, 1750-rpm, totally enclosed motor mounted on the side of the fan pedestal.

A rectangular multilouver type damper, developed especially for use with positioning combustion control systems, is mounted on the fan inlet. This damper has splitters with stops at the blade control edges and felt seals at the blade side edges, and it provides nearly straight line air flow vs actuator setting characteristic from the fully open damper position to shutoff. At this particular installation, seven-percent shutoff was obtained by using an air seal between the fan casing and shaft and by completely enclosing (except for operating shaft) the four sides of the damper frame to reduce leakage around blade shaft ends.

Gas and oil can be fired by the circular register type combination ring gas and steam atomizing oil burner. The register on this unit contains 20 shutters or louvers, set on a circle to control the swirl of air entering the annulus between the two frames of the register. Both the gas ring and throat tiles incorporate modern flame retention features to assure that the gas flame remains anchored to hot refractory at all firing rates and to prevent "flame-out" under the most severely adverse air-fuel ratio—minimum gas flow at maximum air flow.

Oil Burner

Fig. 4 is a cross-sectional view of the steam atomizing oil burner. When appropriately sized, this type of burner has been used successfully for heat release rates from 1,000,000 to 44,000,000 Btu per hr, using fuel oils from cold diesel oil to the heaviest of petroleum pitches heated to 550 F, and at a maximum operating burner steam pressures of from 15 to 150 psig. Steam consumption for atomization at maximum firing rate is as low as 0.10 lb of steam per lb oil —or approximately 0.67 percent of the total boiler output.

One distinctive feature of the combination burner is the utilization of automatic control to position the register louvers for varying load de-

mands. This arrangement produces optimum swirl at all firing rates, and provides an almost flat efficiency curve for either gas or oil over the entire air-throttling range. In addition, the consequent reduction in excess air permits an oil firing range heretofore considered practical only for gas firing.

Firing Cycle

Since momentary power interruptions are very infrequent and do not pose a problem in the San Francisco bay area, semiautomatic firing was selected for this installation because of its simplicity. Control of the firing cycle, even though manually actuated during the start-up and shutdown periods, is through the limit control and flame safeguard control circuit. When starting up, after all limit controls are satisfied—indicated by a white light on the panel—depressing the start pushbutton energizes a red indicating light, the ignition electrode, and the gas pilot solenoid valve (for a timed period of 20 seconds). As soon as the lead sulfite cell type scanner "sees," and the flame safeguard system "proves," the gas pilot flame, the start button indicating light goes off, and the appropriate manual reset fuel valve (gas or oil) is energized. This valve then may be opened manually to ignite the main flame.

At the end of the ignition period the pilot goes out and the scanner supervises the main flame. Firing rate is at 25-percent position or less during start-up and is only changed manually, until put under control of automatic pressure controller, at the firing rate called for by its demand position. For light-off on oil, the operator must have circulated hot oil up to the boiler front, bled water from the atomizing steam line, connected the atomizer, and opened appropriate manual valves before depressing the start button.

There are five limit controls that must be satisfied before the white light on the panel indicates that the manual start-up of the ignition cycle can begin. These are: (1) low water cutoff, (2) forced draft interlock (air-flow switch), (3) purge position switch (damper open), (4) low fire start switch (25-percent position), and (5) high pressure limit switch. At start-up (2), (3), and (4) must be "made" sequentially. The forced draft fan must have been started and the air flow proven by (2); the manual control station must have been moved to high fire position to purge the furnace with the damper open to satisfy (3); and the damper must have been returned to the 25-percent position to satisfy (4). In addition the boiler water level must be above the setting of the low water cutoff and the boiler pressure must be below the setting of the high pressure limit switch. Only then will depressing the start button result in sparked light-off of the gas pilot ignitor.

Combustion Controls

Combustion controls are the simple positioning type and include three principal components: (a) a precision throttling air flow device (the lever operated damper previously described), (b) a precision throttling fuel flow device, with adjustable flow characteristic to match fuel flow to air flow over the load range (suitable lever operated cam valve), and (c) a single manual control station with precision mechanical interconnection between the air and fuel flow throttling devices. The precision throttling fuel valve for gas firing is shown in Fig. 5. A similar adjustable cam, balanced plug design valve is used for oil. Control shafts are mounted in sealed ball bearings, and all operating levers are pinned to their shaft after combustion control settings are completed.

Automatic operation is obtained by applying a hydraulic (oil) operated pressure controller and power unit to the control system. This unit has extreme sensitivity, moving on almost imperceptible pressure changes, and it holds the boiler pressure within 3 to 4 psig of the control setting over the entire load range. It has ample power to permit the addition of a second boiler, includes provisions for future operation at 300-psig, and requires very little maintenance. In fact, a similar water actuated unit in the main boiler room operated continuously for 15 years before any appreciable parts replacement was required.

With positioning combustion controls, of this type, both high and low firing rates must be established before attempting to adjust the system for intermediate firing rates. The basic initial problem with a constant speed fan is to adjust damper setting limits to provide proper air flow for maximum firing rate — based on either fuel—at the open position, and also to mechanically obtain correct low fire with the damper just closed. This is not always easy as it generally involves arranging for a period of operation at the high firing rate, and linkage adjustment can be troublesome. Despite these problems and certain mechanical difficulties, satisfactory high and low gas firing rates were established for this unit in three days time.

Gas Firing Tests

Details of acceptance test results with gas firing are shown in Table 1. These data, all as actually established in the field with Orsat equipment and the boiler instrumentation,

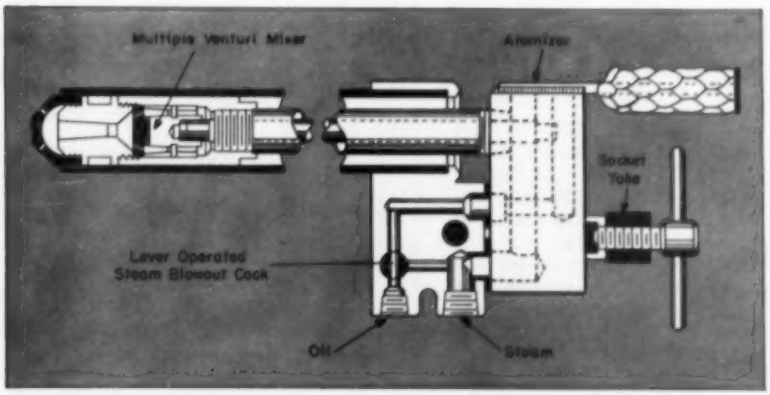


Fig. 4—Coen "MV" steam atomizing oil burner atomizer, socket, and guide pipe.

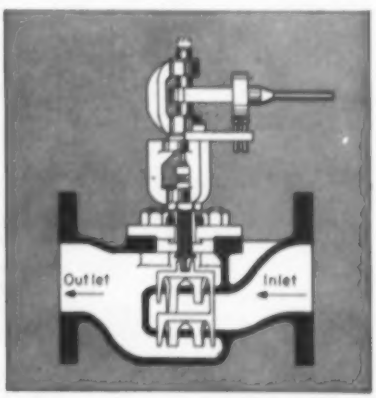


Fig. 5—Coen "AC" gas firing valve.

TABLE 1 — BURNER SETTING AND PERFORMANCE DATA FOR GAS FIRING

Quadrant position index	Register louver position	Gas ring pressure	Draft readings in. wc windbox	Draft readings in. wc furnace	Supply pressure at valve	Supply pressure at meter	Efficiency CO_2 %	Efficiency O_2 %	Efficiency stack °F	Furnace conditions and remarks
1 (min)	0.5	.4 in. wc	-.10	-.19	5 lb	14 oz	10.4	13.0		Minimum fire very stable. Flames about 14-in. long.
2	1	2.7 in. wc	0	-.18	"	"	10.4	13.1	375	
3	1.3	5 oz	0.1	-.175	"	"	10.5	12.9	405	Flame ends visible from 1st side peephole.
4	1.6	12 oz	0.5	-.15	"	"	10.6	12.7	460	
5	2	1 lb 10 oz	0.95	-.1	"	"	10.5	12.8	490	
6	2.1	3 lb	1.75	.1	"	"	10.8	12.6	505	
7	2.4	3 lb 14 oz	2.5	.4	"	"	10.8	12.6	510	
8	2.5	4 lb 3 oz	3.1	.5	"	"	10.5	12.8	520	
9	2.7	4 lb 6 oz	3.4	.6	"	"	10.4	12.9	540	Flame ends visible from 2nd side peephole.
10	2.9	4 lb 9 oz	3.75	.65	"	"	10.2	12.9	560	Fire box very clear. Rear wall orange red.

Note: 1st side peephole approximately 2 ft from front wall; 2nd side peephole approximately 8 ft 2 in. from front wall.

attest to the capability of the burner in providing a flat combustion efficiency over an unusually wide firing range of 14.4 to 1. They also demonstrate excellent boiler design, as indicated by the low stack temperatures at all ratings, including a maximum output of over 10 percent above design capacity. Both Orsat readings and stack temperatures—measured with a shielded FeC thermocouple—were taken at the same point in an uninsulated breeching.

Low load performance is particularly interesting. The special provisions to assure tightness of the burner, windbox, fan, and boiler casing permit a minimum firing rate at only 7-percent air flow into the windbox. Even at this rating there is no evidence of air leakage, under the negative furnace (and windbox) draft. The ability to utilize this very low air flow to provide essentially "perfect" combustion, over a range not ordinarily obtainable, is a substantial credit to the burner and the precision throttling controls.

After the air flow for maximum firing rate had been established on gas firing, the setting for oil firing required only the matching of oil flow to air flow over the firing range from low to high fire. This was accomplished by adjusting of the oil valve and also the atomizing steam valve —an effort that required a total of 2½ days, including the running of acceptance tests with oil firing.

Oil Firing Tests

Tests for determining performance under substantially steady load conditions were conducted with the boiler continuously oil fired at near

TABLE 2 — BURNER SETTING AND PERFORMANCE DATA FOR OIL FIRING

Quadrant position index	Register louver position	Burner header pressure, psig oil	Burner header pressure, psig steam	Draft readings in. wc windbox	Draft readings in. wc furnace	Supply oil psig	Supply oil °F	Supply steam psig	Efficiency CO_2 %	Efficiency O_2 %	Efficiency stack °F	Furnace conditions and remarks
1 (min)	0.5	16	34	-.2	-.26	128	119	120	14.0	16.7		Furnace clear, fire stable. Flames about 18-in.long.
2	1	25	43	-.1	-.25	125	115	118	14.0	17.0	320	Flame ends just visible from 1st side peephole.
3	1.3	35	50	.1	-.22	125	100	115	14.0	16.9	330	Flame absolutely clear — no sparklers.
4	1.6	44	64	.4	-.19	125	118	114	14.2	16.9	350	
5	2	59	77	.9	.1	125	118	108	14.4	16.8	400	Flame ends just visible from 2nd side peephole.
6	2.1	67	81	1.9	.4	125	125	103	14.0	17.0	450	
6½		69	83	2.2		125	155	95	14.4	16.3	470	
7	2.4	70	85	2.55	.47	125	152	97	14.2	16.4	480	
7½		72	85	2.95		123	150	98	14.5	16.2	500	
8	2.5	75	85	3.15	.5	122	145	95	14.6	16.1	540	
9	2.7	80	92	3.65	.6	132	150	100	14.2	16.2	560	
10	2.9	85	95	3.82	.7	130	150	100	14.4	16.3	580	Flame reaching rear fire wall.

Note: 1st side peephole approximately 2 ft from front wall; 2nd side peephole approximately 8 ft 2 in. from front wall.

design output. Gear type meters were installed in the feedwater line and in the oil supply line at the boiler. A three hour test run after firing the boiler at approximately test conditions for six hours provided the following results. Values are averages for the test with readings having been taken at 15 minute intervals:

Boiler pressure	152 psig
Feedwater temperature	215 F
Feedwater metered	2726 gph
Stack temperature (start)	525 F
Stack temperature (end)	540 F
Ambient temperature	60 F
Burner oil pressure	74 psig
Burner steam pressure	83 psig
Burner oil temperature	150 F
Fuel oil metered	193.3 gph
Stack gas CO_2	14.6%
Stack gas O_2	1.8%

From these data and the characteristics of the No. 5 fuel oil—18,255 Btu per lb and 0.94 specific gravity—the following calculations were made, assuming a fuel oil analysis of 85.73% C, 10.92% H_2, 0.96% S, 1.85% O_2, 0.46% N_2, and 0.08% ash:

Steam output	21,797 lb/hr
Heat output	22,022 kBtu/hr
Heat input	27,730 kBtu/hr
Over-all efficiency	79.42%
Sensible heat loss	9.77%
Hydrogen loss	7.03%
Moisture in air	0.27%
Radiation loss (ABMA)	1.37%
Unaccounted for	2.14%

Performance results at other ratings (Table 2) show that oil firing provides the same 14.4 to 1 range as gas firing, with comparable combustion efficiencies over the entire range. The burner draft loss at maximum firing rate is substantially the same for both fuels, although somewhat more output is obtained with oil firing. It should be noted that the boiler outlet dampers are pinned at approximately 50-degrees open, and differences in draft readings at lower loads are not unexpected in view of the stack height.

Results

During the first eight months after the boiler was put into service, its availability was 100 percent. Then the unit was shut down for inspection. After the internal condition was found to be satisfactory, the boiler was returned to continuous operation. Average daytime loads during the week are approximately 10,000 lb per hr, and minimum weekend and nighttime loads are about 6500 lb per hr. Every phase of operation of the boiler and its firing equipment has proven satisfactory, and plant personnel expect the reliable and efficient performance, obtained to date, will be maintained.

LIST OF PRINCIPAL EQUIPMENT

Steam Generator

Steam generator — Erie City type VLP integral furnace packaged water tube boiler

Boiler Accessories

Safety valves — Consolidated No. 1415
Blowoff valves — Yarway No. 3486/88
Feed stop valve — Lunkenheimer No. 1720
Feed check valve — Lunkenheimer No. 1598
Soot blowers — Vulcan FG-3

Windbox-Burner-Fan

Windbox — Coen scroll design with integral throat tile support ring

Burner

Register — Coen BF-17 combination gas and oil burner, drawing 275-130
Atomizer, steam — Coen "MV" with integral blowout cock, drawing 440-70
Fireclay throat tile — Coen, 16 pieces circular tile
Flexible hose — American metal steam and oil hose

Fan

Blower — Sturtevant No. 717, belt driven
Motor — Westinghouse, 7½ hp TEFC
Damper — Coen "Slow Opening" inlet damper

Boiler Mounted Control Center

Automatic combustion control

Proportional controller and power cylinder — Coen "HO" with hydraulic pump set, bulletin 40
Single manual control station — Coen "Boiler Mount" manual control station, drawing 400-20
Firing valves, gas — Coen "AC" lever operated adjustable cam control valve, bulletin 40-1
Firing valves, oil — Coen "AC" lever operated adjustable cam control valve, bulletin 40-1
Firing valves, steam — Coen "AC" lever operated adjustable cam control valve, bulletin 40-1

Ignition equipment and flame failure system

Pilot light — Coen Premix electric-gas ignitor for register with Fireye scanner mount
Ignition electrode — Integral with ignitor with high tension lead wire attached
Ignition transformer — 6,000 volt ignition transformer
Flame failure — Fireye FP-4 system

Safety shutoff valves

Gas pilot valve — General Controls, K-21A F. M. approved ⅜-in. magnetic valve
Gas pilot line strainer — Wye strainer
Oil valve — General Controls, V-110 F.M. approved ¾-in. manual reset magnetic valve
Gas valve — Mason Premix, F.M. approved 3-in. manual reset magnetic valve

Limit controls

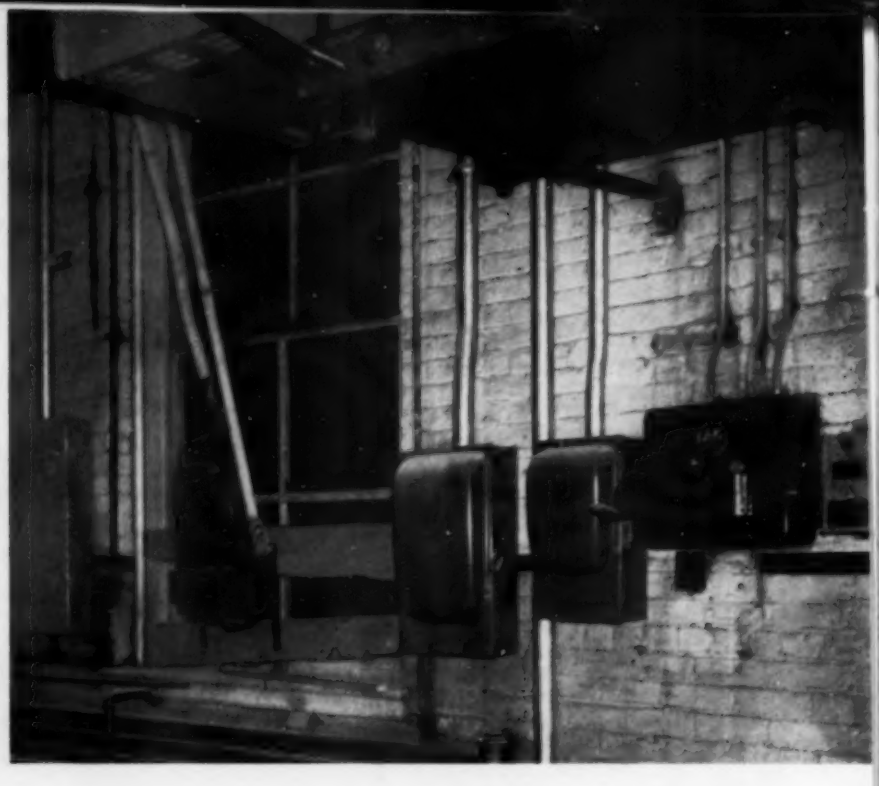
Overpressure — Minneapolis-Honeywell L404A Pressuretrol
Purge position switch — Micro-Switch
Air switch — Dewey 114A Diaphragm switch
Low fire start switch — Micro-Switch

Piping accessory equipment

Oil thermometer — 6-in. separable socket, range 50 to 400 F
Gas pilot pressure regulator — Service regulator, pounds to ounces
Oil and steam strainers — Wye strainers, two oil and one steam
Oil and steam pressure gages — Four pressure gages with 3½-in. dials, range 0 to 200 psig
Gas pressure gages — Two pressure gages with 3½-in. dials
Steam trap — Armstrong, ½-in. with integral strainer
Atomizing steam PRV — Cash 1000 HP pressure reducing valve

Electrical accessory equipment

Electric starter — Westinghouse No. 1 magnetic starter with pushbutton, 440 volt 3 phase
Control disconnect switch — Fused disconnect switch, 110 volt
Prepurge timer — Agastat time delay relay, adjustable
On-off switch — Westinghouse Oil-Tite SPST rotary switch
Fuel selector switch — Westinghouse Oil-Tite DPDT rotary switch
Ignition timer — Agastat time delay relay, 15 seconds
Ignition pushbutton — Westinghouse Oil-Tite DPDT industrial type
Ignition holding circuit lamp — Westinghouse Oil-Tite signal light, red
Alarm horn — Federal alarm horn
Signal light — Westinghouse Oil-Tite safety shutdown, red
Signal light — Westinghouse Oil-Tite limit control, blue



To make room for new a-c lighting panel (extreme left), old d-c motor starter was moved to temporary spot on window (left of the new a-c switches.)

I&P EXCLUSIVE

MURPHY SHELL
Manager, Electrical Engineering
Parke, Davis & Company

How We Scheduled a D-C to A-C Changeover

When you get the OK to replace an old d-c system with a modern a-c system, you have the problem of maintaining production during the change. Here's how Parke-Davis did it.

DURING CHANGEOVER of an industrial plant from d-c to a-c power, it is of prime importance to maintain production schedules as far as possible—particularly in a pharmaceuticals plant. Certainly, it is the duty of the engineers responsible for the program to arrange scheduling and off-shift operations to reduce production down-time.

At Parke, Davis & Company the problem was, and is, to change over from an isolated d-c system to an a-c system. The company maintains its own d-c generating equipment and distribution system, with no emergency or standby service from any other source. The a-c energy is purchased from the Detroit Edison Company at 4800 volts. Parke-Davis owns and maintains its own primary distribution system, substations, load centers, and secondary distribution.

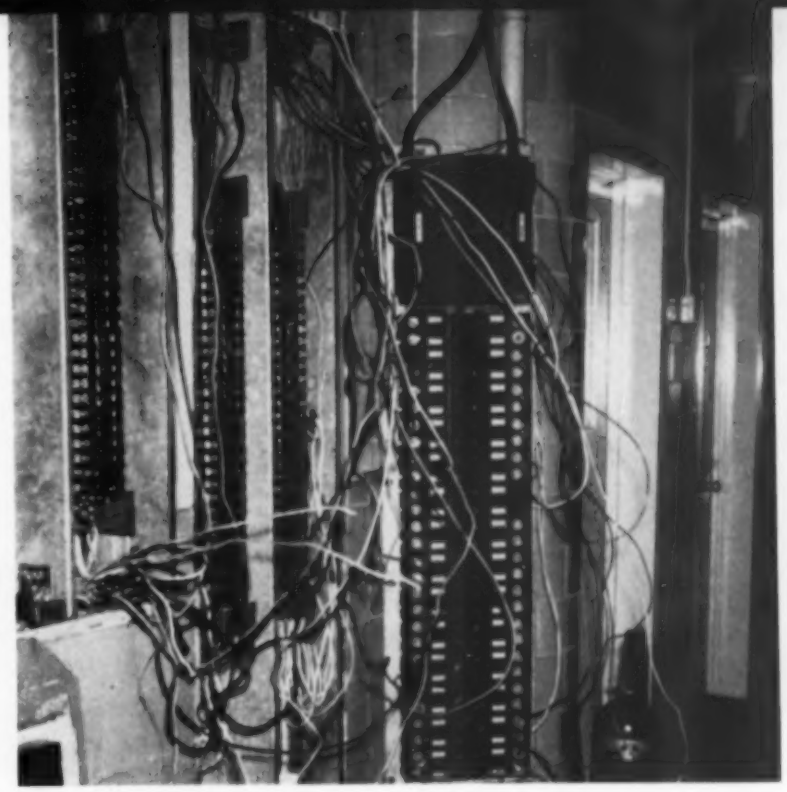
The present d-c system for lighting and power is 120-volt, two-wire, ungrounded. The a-c system for power and plant-wide secondary distribution is 480-volt, three-phase, three-wire, 60-cps, ungrounded. Lighting and small motors are supplied by either a 120/240 volt, single-phase, three-wire, grounded neutral system, or by a 120/208-volt, three-phase, four-wire, grounded neutral system. Generally speaking, most of these low-voltage lighting systems are supplied by isolation transformers, which are connected to the 480-volt secondary distribution system. In some of the earlier installations in areas where the power demand is low, however, the substations consist of two transformer banks—one for lighting and one for power. Both banks are connected to the same 4800-volt primary feeder.

This apparent mix-up in lighting voltages is a result of many factors. Since the time when the a-c was first introduced in the plant, the system grew helter-skelter until an organized plan of changeover for the entire plant was adopted during the first part of 1949.

Prior to final approval to change over the entire electrical system, the existing a-c system had passed through many stages. The first a-c in the plant was produced in 1915 with a 120-kva, 440-volt, 60-cps motor-generator set fed from the plant's d-c system. In intervening years, the source of a-c power was expanded to include various substations served by The Detroit Edison Company at 4800 volts from overhead lines. In 1947, a primary switch house was erected. This building serves as a primary distribution center for the 4800-volt energy purchased from Detroit Edison.

Between 1915 and approval of the changeover plan in 1949, the plant had accumulated a maze of a-c distribution systems and branch circuits that would almost defy recognition or reasoning. Hence, one of the first problems to be confronted in the changeover program was to plan and install an orderly distribution system for the entire plant.

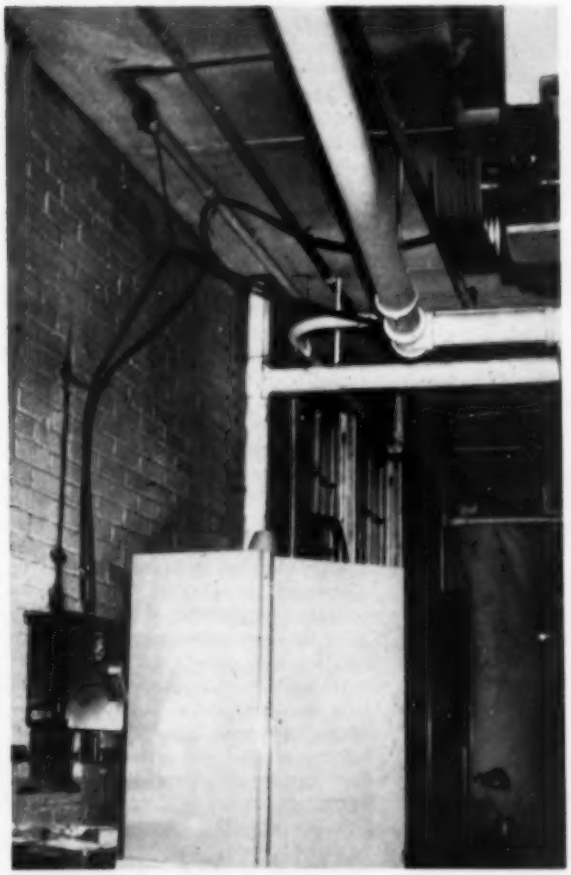
The installation of the permanent a-c distribution system became the first scheduling problem. In many cases, the ideal location for the a-c equipment (such as feeders, load centers, power and lighting panels, and bus duct) was the same spot as



Old d-c plug-fused lighting panel being replaced by a-c breaker panel having over double capacity.

occupied by the present d-c equipment. In these instances, there were two choices: accept an alternate location, or temporarily relocate the d-c equipment so that the a-c equipment could be installed. The first choice presented no scheduling or down-time problem. This choice was used in many instances.

There were probably an equal number of instances where the second alternative had to be selected due to building construction, recessed panels, or lack of space. In these instances, a schedule of operations listing approximate down-times, affected areas, and affected equipment was presented. After discussing the operations with the departments involved, a suitable time would be decided upon. It goes without saying that in many cases the only acceptable times were during



"Back-fire" motor installation is temporarily fed a-c from floor through starter and service cord.

REPAIR REQUIRED NOW
SERVICING REQUIRED

INSPECTION TICKET
ELECTRIC !
(MOTOR & GENERATOR)

P. O. NO.
DATE

BLDG. NO. | FLOOR | DEPT. NO. | SECT. NO. | INSPECTION TIME: START | END

USED TO DRIVE/POWER | GENERAL CONDITION: EXC. | GOOD | FAIR | POOR | BAD

MFG. NAME | MFG. SERIAL NO. | R.P.M. | H.P.

MFG. TYPE NO. | TYPE OF UNIT

RATED VOLTAGE: 110 | 220 | 440 | OTHER | A.C. | 1 PH. | 3 PH. | D.C. | RATED CURRENT: AMP.

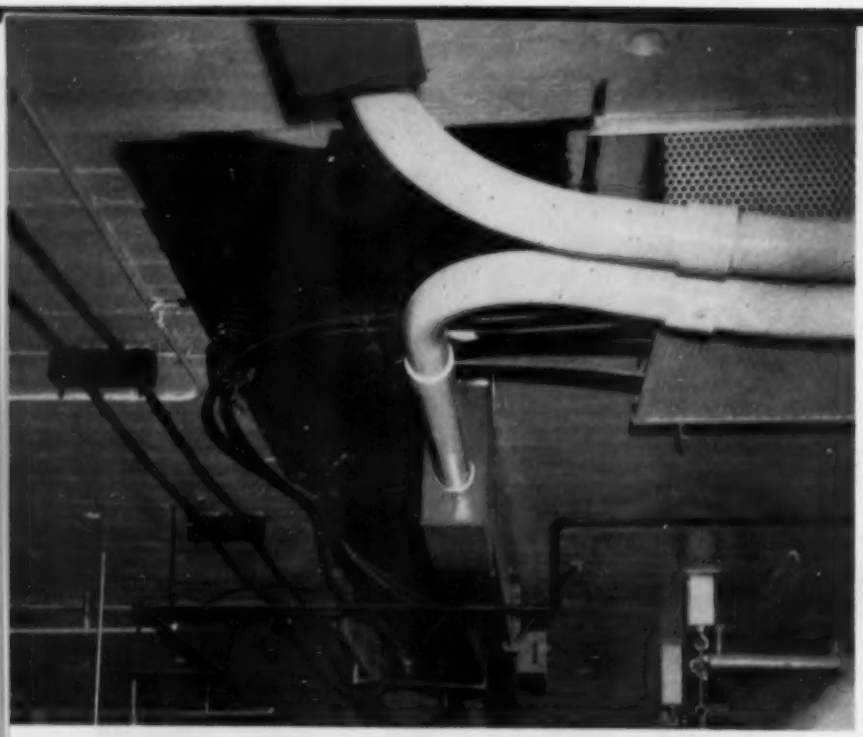
NO.	INSPECT	X	NOTES OR WORK REQUIRED
1	NORMALLY CLEAN?		
2	MOUNTING SNUG? (TORQUE)	LBS.	
3	SOUND/VIBRATION		
4	OPERATING TEMPERATURE (THERMO.)	°C.	
5	AIR GAP CLEARANCE (FEELER)	"	
6	BEARINGS (& END PLAY)		
7	SPEED (TACHOMETER)	R.P.M.	
8	LUBRICATION		
9	DRIVE (TYPE)		
10	V.A. READING (V. / A.)		
11	WIRING (FROM STARTER / TO DEVICE)		
12	INTERNAL WIRING		
13	BRUSHES (TENSION & % WORN)	%	
14	COMMUTATOR		

A TICKET MUST BE MADE FOR EACH MOTOR OR GENERATOR

INSPECTOR

FORM 1361.1 (AUG. 52) (SO 196)

Inspection tickets filled out for preventive maintenance program gave valuable data for changeover jobs.



D-c feeder bus was removed (from dark area) to make room for new a-c plug-in duct (bottom center). Some d-c wire and bus jumpers still have to go.

off-shift hours. Much of the changeover work was done during weekends and, in some cases, on round-the-clock schedules in order to reduce down-time.

In many cases there were preliminary stages leading up to the actual job to be scheduled. Sometimes a particular piece of apparatus could not be down for the required time; in these cases, a temporary d-c line was run to the equipment to permit disconnecting, moving, and re-connecting to the main d-c panel or feeder on a temporary basis.

A-C Modernization

Along with scheduling the installation of the permanent a-c system, removal had to be scheduled for the random a-c system that had grown up through the years. This problem was not so difficult and usually would involve one or two pieces of equipment at a time. Here, the problem was to disconnect from the existing a-c system and re-connect to the permanent a-c system. A familiar question that was asked on these jobs was, "Why do you have to disconnect this equipment? It's already operating on a-c!"

After approval of the changeover program, the decision was made that all new or replaced equipment would be a-c. No more d-c equipment would be bought. Although this was a logical decision in view of the general effort to eliminate the d-c, it also presented many problems. Since it is impossible to design and install a complete a-c distribution system overnight, one problem arose because the normal expansion and modernization program of the plant could not be held back. Every department in the plant immediately began requesting new or additional equipment, all specified to be a-c. Many of the areas where this equipment was to be located had no a-c yet, and would not have it for several months. In the meantime, the equipment had to operate. This condition was met by doubling up on any a-c circuits available. Sometimes there were open, temporary a-c feeders or branch circuits set up from one floor to another or from one building to another. In places where there was 480-volt a-c available and 120-volt service was required, there were 2- to 5-kva transformers installed on a temporary basis.

Though it was impossible to keep up with every modernization and expansion project within the plant, only a few installations were delayed, and then for but a short time. The biggest delay in the modernization program is the installation of fluorescent lighting systems. This item is not too critical in many areas and can be delayed without serious effects.

Three Fronts

The work of changing over the plant might be considered as progressing along three fronts: distribution systems, emergency replacements, and replacements planned in advance.

The changeover of the distribution system, as already mentioned, is nearing completion. The second item—emergency replacements—has been and still is the biggest source of trouble because it is something that cannot be scheduled. By emergency replacement is meant the sudden failure of a piece of d-c equipment. In these cases there are three choices: make a temporary repair and immediately order the a-c replacement; obtain a d-c replacement from another part of the plant; or shut the equipment down and obtain an a-c replacement.

Need and Availability

The choice among various solutions is influenced by the need for the equipment and the availability of the a-c replacement. There have been times when equipment was repaired that should have been scrapped, but the equipment had to operate and any delay to obtain the replacements could not be tolerated.

There have been occasions where some of the emergency replacements have "back-fired" and caused a little embarrassment. These situations result from the failure of a repair job or, what is worse, from the failure or improper operation of the a-c replacement. The latter can be due to lack of time to properly engineer the replacement. That is, a-c equipment was installed in an emergency. The nameplate data compared to the nameplate data of the d-c equipment. It was found out too late that the machine had been operating under overload conditions, or else that the d-c motor had been operating above or below nameplate speed. In these cases, temporary repairs were made to keep the machine running as well as possible while proper replacements were ordered. The machine would then be stopped and changed a second time.

Three Planned Routes

The planned portion of the replacement program followed three routes: changeover of large motors in order to reduce the peak demands on the d-c generating equipment; investigation and ordering of special, long delivery items in order to reduce the down-time in the event of failure of the d-c equipment; and changeover of entire areas or departments in order to reduce confusion, to simplify scheduling of department operations, and to effect savings as a result of tradesmen's familiarity with similar installations.

Usually, the scheduling for this

portion of the replacement program was fairly simple. The department manager or section head would be contacted and a changeover time agreed upon. Most pieces of equipment have normal down-time anyway for such activity as cleaning, inspection, or routine replacement of certain parts. The changeover could be done during these times.

Quick Changeovers

On some machines, the normal down-time occurs during the off-shift. On other machines, whose normal down-time is rather infrequent, the changeover job is expedited by having such things as branch circuits, starters, and control stations installed in advance. The equipment is then replaced during lunch periods or between shifts. Admittedly, this is an inefficient method because it means dispatching the work crew a second time with duplication of travel time and re-learning what had been a familiar job. However, the down-time on the equipment is reduced, which may be of the utmost importance.

It became apparent that the program could be expedited by expanding stores inventory. Mechanical stores already existed that included materials for carpenters, millwrights, and electricians. To these stores were added such items as motors, motor starters, bus plugs, conduit racks, lighting fixtures, lighting panels, and transformers. The supply of these items eliminated a great deal of paper work for individual purchases from outside sources. It was also very effective in reducing down-time for replacement of the more-or-less standard items.

Preventive Maintenance

In 1951, Parke-Davis instituted another program that was very beneficial to the changeover program. This new program was preventive maintenance. Although preventive maintenance was entirely separate and had no bearing on the changeover program, its potential was soon realized and advantage was taken of its inspection reports.

Preventive maintenance is primarily charged with inspecting and checking the condition of all mechanical equipment within the plant, and making recommendations for necessary repairs. Included on the staff are two electrical inspectors who inspect all motors, controls, switches, and other electrical apparatus. During their inspections of motors, both a-c and d-c, they record nameplate data as well as operating data at the time of inspection. These men have made two complete rounds and are now on their third trip through the plant to inspect the electrical equipment.

As a result of these inspections, data is available in the event a piece of d-c equipment fails. The inspectors' reports show actual terminal voltage, load current, speed, and other pertinent information that is very useful in deciding upon an a-c replacement. Quite often there are differences between the data actually recorded and the nameplate data due to rewound armatures, added resistances, or just plain overloading. This information is now used instead of depending entirely upon nameplate data as had been done in the past. Changeover "back-fires" have been considerably reduced.

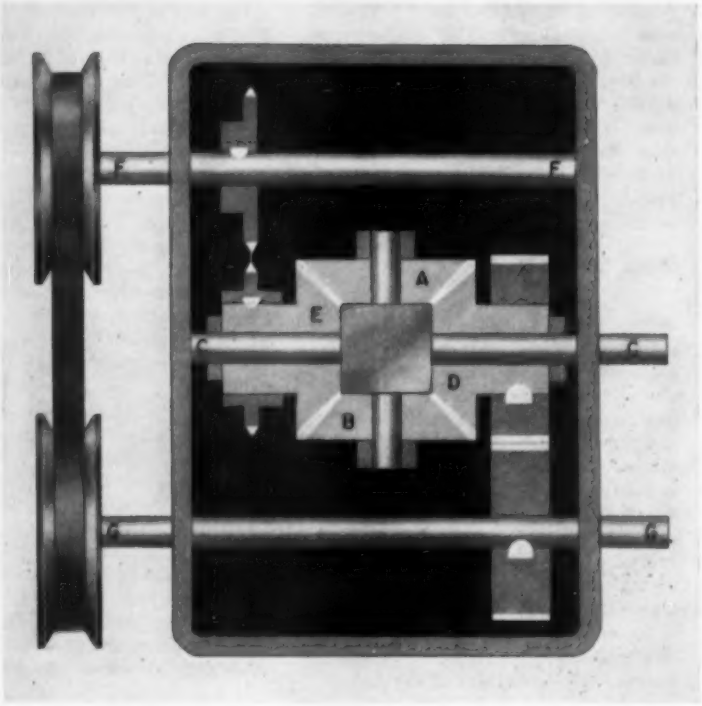
Another procedure used to keep the program moving is to concentrate engineering effort. At the beginning of the program, all electrical engineering personnel did engineering for the changeover as well as for other projects about the plant. Here, as in the shops, there would be times when the program would be bypassed in favor of other projects. The efforts of certain individuals are now concentrated so that they work almost entirely on the changeover program. The other electrical engineers also work on the program if such work is convenient to other projects assigned them.

The removal of the d-c system is not too important from a scheduling standpoint. The biggest factors in favor of quickly clearing away the d-c system are the cleaning up of the areas and the relieving of underground ducts and raceways for installation of the a-c system.

At present, the basement ceiling of the power house is pretty well crowded with d-c bus, a-c conduit, and other piping. A fairly large area in the turbine room is occupied by d-c switchboards that are still in use. Although this cannot all be removed until the end of the program, a certain amount of the d-c distribution system has been cleared out in other portions of the plant.

Typical changeover problem is one where new conduit had to be run in around exposed d-c breakers and bus without cutting off d-c service to loads.

Fig. 1—This schematic diagram shows the functional mechanism of a differential transmission.



I&P EXCLUSIVE

New Drives Give Wide Range Of Variable Speeds

RICHARD LeB. Bowen Jr.,
Coated Textile Mills Incorporated

IN MANY INDUSTRIAL applications it is desirable to start a machine at a very slow speed, bring it up to full speed slowly, and then provide a limited amount of variation at operating speeds. With certain types of machinery it is also desirable to decelerate slowly before stopping completely. It is for such controlled acceleration and deceleration—with variable speed at operating range—that the wide range variable speed transmission is designed. Most variable speed experts agree that so far as operating range of machinery is concerned, a 4:1 speed variation will probably take care of 70 percent of the applications, while a 6:1 range will take care of perhaps 90 percent. There are other drives where stopping and starting are not important, but a wide range of operating speeds, such as 100:1, is often desirable.

Principles

Many of these wide range mechanical transmissions operate on a differential principle. Some actually incorporate a differential gear train in the transmission, others simply use some differential elements. A differential gear train by itself is not capable of producing controlled variable speeds. But when coupled with a variable speed mechanism with a limited ratio of 2:1 or even less, the differential immediately becomes a most versatile variable speed transmission capable of producing an infinite range of speed variation from any selected drive speed down to zero or reverse.

A differential gear train consists of three power transmitting elements, and is best known as used in the automobile rear end. Power is applied to one element of the differential, and is transmitted to the other two elements. The speed of the third element is determined by the speed of the input shaft and the speed of the second element. In the automobile the two driven elements travel at the same speed unless the vehicle is going around a corner, or unless one wheel slips on ice or a wet pavement. Then one wheel travels faster than the other. In making a variable speed device out of the differential, power is put into one element at a constant speed, and a second element is allowed to turn at a varying speed. This produces variable speed in the third element which becomes the output shaft of the differential.

Two Types

There are two main types of differential gear trains: the bevel gear and the planetary gear types. Fig. 1 shows a 1:1 bevel gear differential. Gears A and B are carried on a cross shaft fixed to a longitudinal shaft C which in this case serves as an output shaft. Bevel gears D and E are free to rotate on shaft C and mesh with gears A and B. Gear E is connected to shaft F by sprockets and a chain in a 1:1 ratio; likewise bevel gear D is connected to shaft G by 1:1 spur gears.

Shafts F and G can be connected by a belt and two variable pitch V-pulleys whose pitch diameters can be changed manually. Shaft G can be driven by a motor and serves as the input shaft. When the ratios of the variable pitch pulleys are 1:1, shaft C remains stationary. However, when the ratios of the pulleys are such that shaft G travels faster than shaft F, shaft C will rotate in the opposite direction to G, and at one-half the speed difference between shafts G and F. Likewise, when F turns faster than G, shaft C turns in the same direction as F.

Ratio Magnified

Thus it can be seen that a very limited ratio in a variable speed mechanism applied between two elements of a differential can produce output speeds down to zero and into reverse. Usually reverse speeds are not required, so the ratios of the sprockets and spur gears are designed so that the speed of the output shaft goes from maxi-

mum to zero when the variable pitch pulleys are shifted over their full operating ratios.

These principles have been known for some time, but only in the last few years have any industrial models been available. In the past, the limited ratios of double variable pitch pulleys mounted on parallel shafts, such as the Reeves and the Lewellen transmissions, have been extended by plant engineers and application engineers by coupling a differential to the two shafts of the transmissions. Such has been previously shown in INDUSTRY AND POWER (March 1951) in "Mechanical Differentials Can Solve Transmission Problems." At low or fractional horsepowers, the differential gearing and bearings can be made large enough to outweigh any faults in design, but with large units an engineer inexperienced in machine design is courting trouble by designing such a train himself. Today, there are several companies manufacturing differential variable speed transmissions: some use bevel gears, others use a planetary arrangement.

Specon Unit

The Speed Control Division of Fairchild Engine and Airplane Corporation has coupled a differential gear train to the two shafts of a Link-Belt PIV variable speed transmission (Fig. 2.) This transmission is composed of two independent shafts with variable pitch pulleys splined to the shafts. The conical faces of the pulleys have radial grooves, that receive a unique self-tooth-pitching chain. A pair of levers on each side of the grooved sheaves forces the pair of disks toward each other. The levers are pivoted at the center and provided with a linkage at one end for simultaneously and oppositely changing the pitch diameters of the two pulleys. A bevel gear differential gear train is housed in a casing that is bolted onto the Link-Belt transmission. Spur gear reducers are incorporated in the housing so that maximum output speeds of from 100 to 7000 rpm are available. The differential can be arranged in two manners, so that at zero output speed either 50 percent or 200 percent of the maximum speed torque is obtained. This is accomplished by connecting the variable speed element of the PIV to different members of the gear train. The torque varies 2:1 in both instances—the torque variation of a pair of variable pitch pulleys with a 4:1 ratio. The units are available in ratings from 1½ to 20 hp.

Planetary Unit

Lombard Governor Corporation also manufactures a differential variable speed transmission (Fig. 3). The differential consists of a planetary gear system, and the variable speed device consists of two variable pitch pulleys and a wide V-belt. Minimum speed is about zero. Power is transmitted in a straight line from the input to the output shaft, and the ratio of the gears is such that with an 1800 rpm motor the maximum output speed is about 200 rpm. Three sizes of units are being made with ratings from 3 to 15 hp.

An extremely ingenious example of this principle is manufactured by Graham Transmissions, Inc. The units are composed of what is essentially a planetary differential gear train, but they do not use any auxiliary variable speed device (Fig. 4). One differential element consists of three tapered friction rollers, and the second differential element consists of a steel nonrotating ring that contacts the outer edges of the three rollers. The rollers are free to rotate on their own axes which are supported by a carrier fixed to the input shaft. At the large end of each tapered roller is fixed a planet gear, which engages a ring gear fixed to the output shaft. This ring gear is the third differential element of the transmission.

Ring Moves

The nonrotating ring is movable longitudinally so that the point of contact with the rollers can be varied from one end to the other. Since the rollers roll on the inside of the ring, and since the carrier rotates the three rollers at a constant speed, it is evident that movement of the ring from one end to the other must change the individual speed of rotation of the rollers. When the ratio of roller diameter to ring diameter equals the ratio of planet gear pitch diameter to ring gear pitch diameter, the output shaft is stationary. At this point the planet gears are essentially rolling around inside the stationary ring gear. When the ring is moved to the

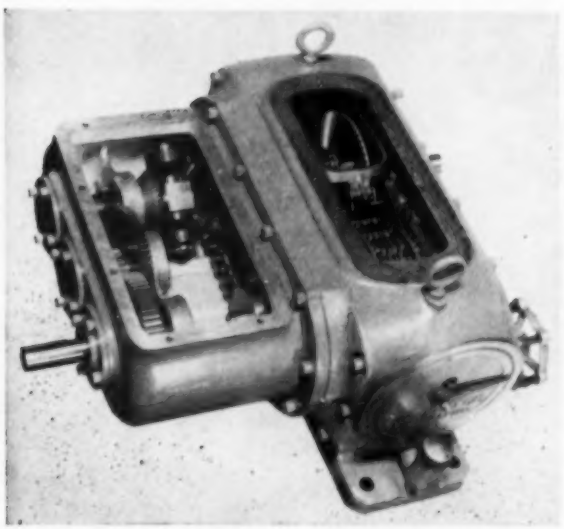


Fig. 2—This Specon transmission combines a differential and a Link-Belt PIV variable speed transmission.

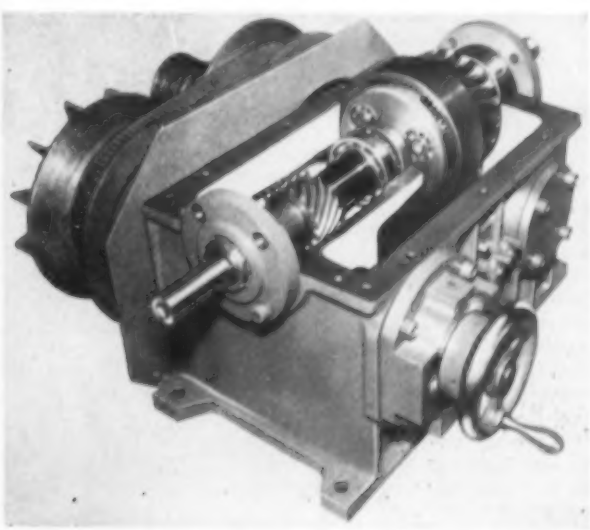


Fig. 3—The Lombard Governor unit utilizes two variable pitch V-belt pulleys and a planetary differential gear.

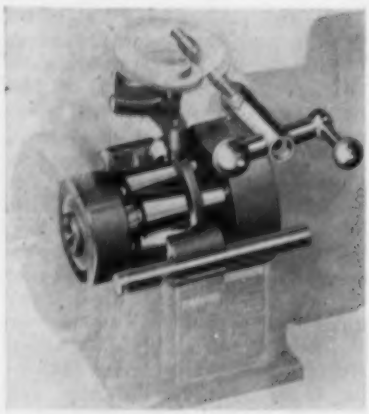


Fig. 4—Protection against overload is provided by the Graham transmission.

large end of the rollers, the individual speed of the rollers decreases, and when moved to the small end the speed increases; this change in speed is transmitted to the output shaft, whose rpm is proportional to the difference between the constant motor speed and the roller speed. The output speed is therefore greatest when the ring is at the large end of the rollers and lowest when at the small end.

Centrifugal force presses the rollers firmly against the ring. Since the rollers are always supported by double bearings at their small ends, the lever arm of the centrifugal force pressing the rollers against the ring in relation to the lever arm of the force at the ring itself, and thus the traction, is greatest when the ring is at the small end (slow speed or reversed). Permissible torque at zero is about three times that of maximum speed. Because of the higher torque at low speeds, the rated power is substantially constant from maximum speed down to about half speed.

Sizes of the units range from 1/15 to 5 hp. They are built in two arrangements. In one the speed range is from about 1/3 input speed to zero (and to 1/100 input speed in reverse); the other has a range from 1/5 input speed forward and reverse through zero. The basic adjusting system is a lever or a worm operated cam. One of the advantages of these transmissions is the fact that they can be adjusted rapidly when running, or can be preset to any speed when at rest (except in a few cases when spring-loaded rollers are used).

Graham transmissions are inherently provided with an overload protection, since they slip without harm. They differ completely from the familiar disk contacting a roller, or a metal ring contacting a pair of tapered pulleys, where slippage will wear a spot on one of the contacting surfaces, causing failure. With the Graham transmission this is not likely to happen since there is always lubricant around the rollers, which revolve at all times. The Graham thus gives automatic protection against excessive torque in event of a jam of the driven equipment, without damage to itself. This transmission often makes slip clutches, shear pins, or other torque-operative protection devices on the machine unnecessary.

Another very ingenious application of the differential principle of obtaining infinitely variable speeds is manufactured by Speed Selector, Inc. There are no gears, the power transmitting elements consisting of variable pitch sheaves and standard V-belts (Fig. 5). An input shaft drives a spider at constant speed, rotating a jack shaft that carries a pair of variable pitch sheaves with adjoining central faces fixed together. One of these sheaves is connected by a V-belt to a variable pitch sheave fixed on the output shaft. The other jack shaft sheave is connected by a V-belt to a variable pitch sheave that remains stationary, one of its faces being fixed to the transmission housing.

A control lever simultaneously and oppositely alters the pitch diameters of the central output and stationary sheaves so that when one is increased, the other is decreased. This change is imparted inversely to the jack shaft sheaves by the wedging action of the V-belts. Thus the control lever effectively controls the pitch diameters of all four variable pitch sheaves. Referring to (Fig. 5), it can be seen that when the pitch diameters are all the same, or 1:1, the speed of the output shaft is zero. Both of the jack shaft sheaves simply make one revolution for each revolution of the spider. Changing the pitch diameters

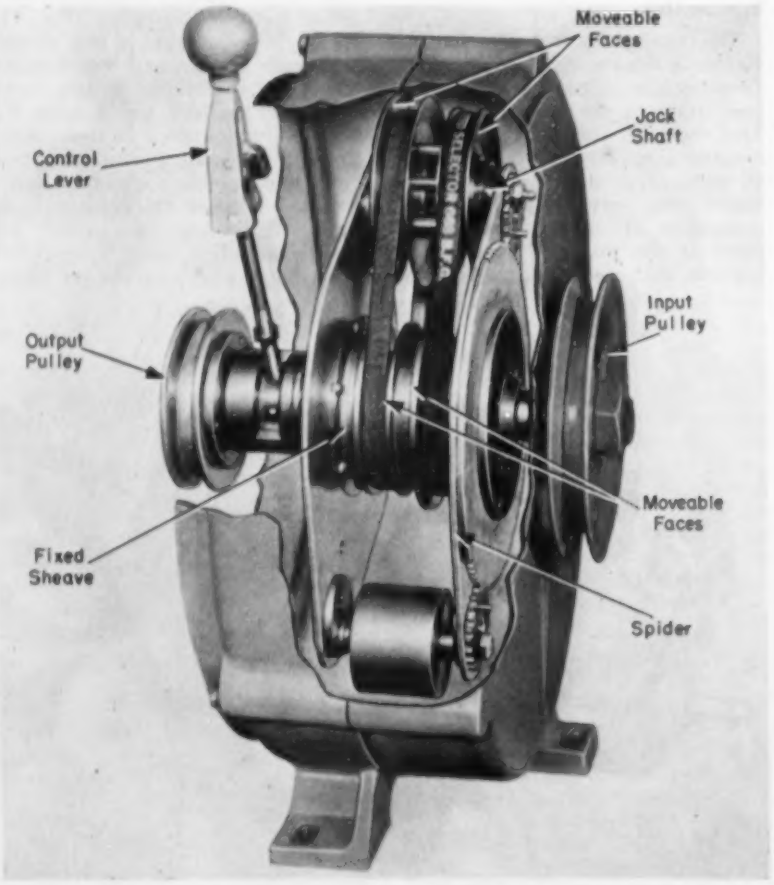


Fig. 5—The Speed Selector unit is basically a planetary differential, with the jack sheave acting as the planet and the output sheave as the sun.

one way or the other produces either forward or reverse motion.

This mechanism is basically a planetary differential. The spider corresponds to the conventional carrier, the jack shaft sheaves to the planet gears, the output sheave to the sun gear, and the stationary sheave to the ring gear. By varying the ratios of speeds between the stationary sheave (ring) and the jack sheave (planet), the speed of the output sheave (sun) is varied.

These units are made in four sizes from ½ hp to 4 hp. Forward speeds are from about one half the input speed to zero, with a maximum reverse speed of about 25 percent input speed. The rated torque for forward motion is constant, while the reverse torque is only about one quarter the forward torque. Maximum allowable input speed of the smallest units is 1300 rpm, and of the largest, 1040 rpm.

Hydraulic System

The problem can also be solved using a differential gear train and a hydraulic system consisting of a variable volume motor and a fixed displacement hydraulic pump (Fig. 6). Variable speed is produced at the differential output shaft by varying the volume of the motor which is connected to the constant speed shaft of the differential. This allows the pump, which is connected to one shaft of the differential, to turn only at a predetermined speed. Thus by varying the displacement of the motor from maximum to minimum, output speeds of from zero to maximum can be obtained. This has certain inherent advantages over the well-known variable volume pump and motor hydraulic system. In the first place, low differential output speeds can be accurately set, since this requires the hydraulic pump to travel in its high speed range. Conversely, when the differential output shaft travels at high speed, the hydraulic pump travels in the low speed range, and most of the power is transmitted directly by gears. In this way, zero speeds can be obtained from hydraulic systems with limited speed ratios.

Two Differentials

There is also a type of variable speed device that utilizes two differential gear trains, arranged in parallel, with a constant speed motor driving an input shaft coupled to both differentials. The output shaft of the unit is also coupled to a second element of each differential, and a variable speed device is connected between the third elements of both differentials. The advantage of this type of transmission over one using a single differential is that the speed controlling mechanism is only half the size required with the single differential.

The only commercial adaptation of this type of differential is manufactured by the Speed Control Division of Fairchild Engine and Airplane Corporation (Fig. 7). The variable speed device consists of two shunt wound d-c generators with the armature circuits tied together. When the output shaft is stationary the generators run at the same speed, with equal field excitation. However, when the excitation is unbalanced, as by a rheostat, the machine with the higher voltage drives the other as a motor, and one differential shaft slows down while the other speeds up. This change in the ratios between two of the differential shafts is reflected by increasing speed in the output shaft. Sizes up to 50 hp are manufactured as standard items. The only space required for the transmission is for the transmission and two generators, if the motor is mounted over the differential.

The system usefully combines the differential and the variable voltage d-c principle, with the generators run only through a 2:1 ratio. The arrangement is readily adaptable to many winding operations, since it is possible to preset different tensions at the start of winding and at the end of winding.

Wide Ranges

It will be seen that many of the units described have the unique ability to go from top speed down to zero and sometimes into reverse. Accuracy of speed control is not forfeited. The currently limited use of these transmissions is undoubtedly due to their rather low hp ratings in most designs. Their application is worth further investigation by plant engineers.

For bulletins and catalogs describing any of these drives in further detail, write Industry and Power, 420 Main St., St. Joseph, Michigan.

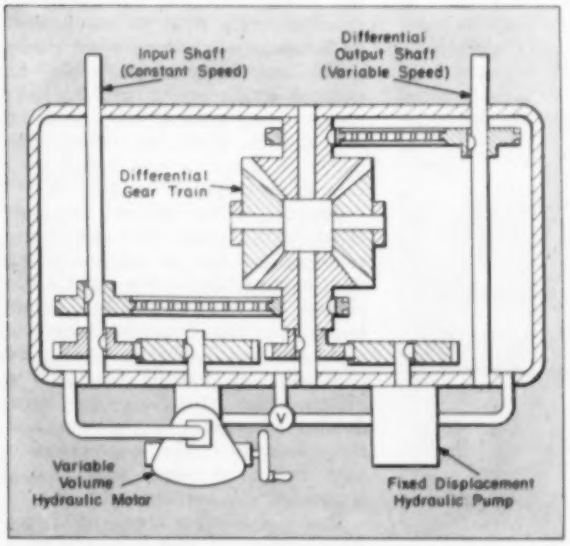


Fig. 6—Here, a fixed displacement pump and variable volume hydraulic motor provide the variable element.

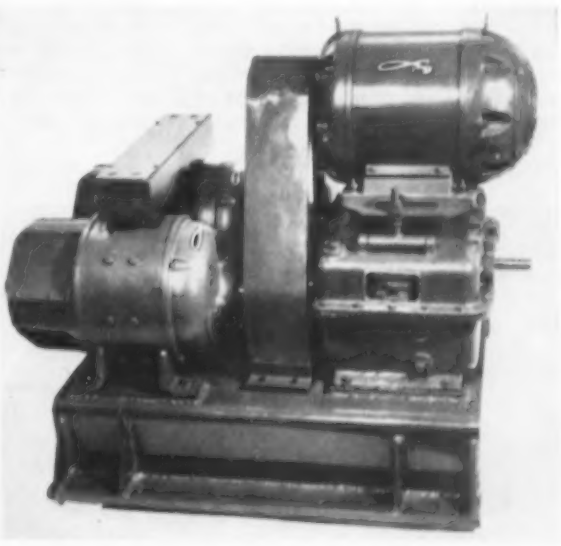


Fig. 7—This Specon Unit makes use of two shunt wound d-c generators with connected armature circuits.

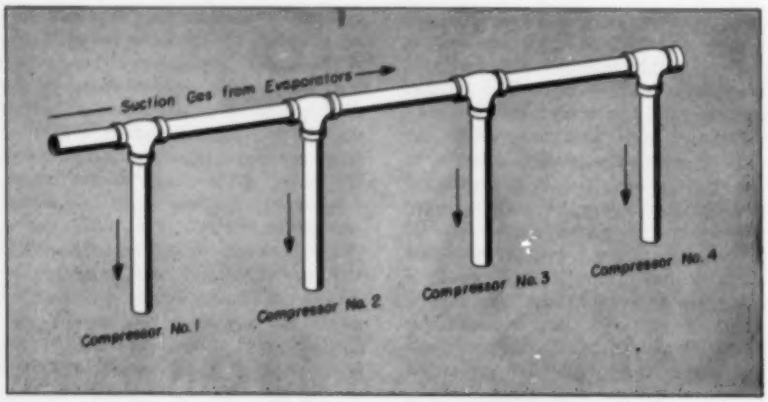


Fig. 1—Wrong Way. Suction to the compressors from downward tees lets liquid collect in the inlet lines.

I&P EXCLUSIVE

Planning Refrigeration Plant Piping Systems

You cannot hope to get rated capacity from a refrigeration compressor if the piping system is selected simply to save a quick buck.

C. T. BAKER
Consulting Engineer

ONE OF THE most important factors influencing the efficiency and capacity of refrigerating plants is the design of the suction piping system. Although manufacturers of refrigerating machinery and design engineers stress the importance of properly designing the suction piping layouts, many plants operate at low over-all efficiency because they are victims of rule-of-thumb methods and befuddled notions that dictate the policy of those responsible for the arrangement of the system.

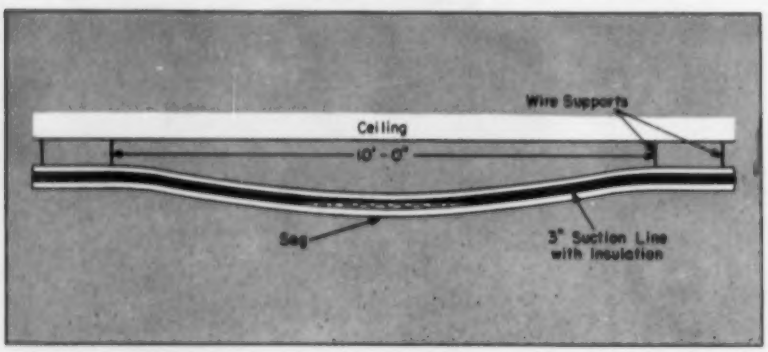


Fig. 2—Pipe supports should be properly designed and correctly spaced. In one plant supports were so far apart that pipe sag formed a liquid trap.

Suction Line Losses

An important factor frequently overlooked is that the over-all length of a line and the number of fittings that must be used have a decided effect on the pressure loss between the evaporator and the compressor. To illustrate this point, lack of knowledge regarding the causes of line losses and the effect of these losses in the compressor suction system caused one plant to fail completely in obtaining the rated capacity from its compressor until costly alterations were made.

The compressor was a 7x7-in. vertical, single-acting machine having a 2-in. suction inlet opening and a 2-in. discharge outlet. Capacity of the unit was based on a suction pressure of 5 psig.

Because of the general arrangement of the plant, the installation required 165 feet of suction piping with a minimum of five right angle elbows. To compensate for friction losses resulting from the long line and numerous elbows, the plant engineer was advised to install a 2½-in. pipe between the two, flooded-coil type evaporators and the compressor. The engineer that sold the evaporators and fittings supported this recommendation.

The plant superintendent, however, contended that it would be a waste of money to use a line larger than 2 inches since no greater

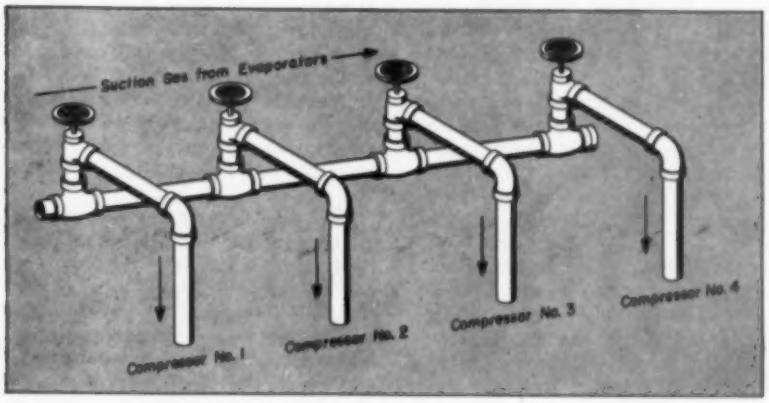


Fig. 2—Right way. Upward tees and angle valves prevent accumulation of liquid in the suction header.

amount of ammonia could enter the compressor than could pass through a 2-in. opening. The manager-owner agreed. Like many others, he had an aversion to spending money. The outcome was that the 2-in. suction line was installed.

When placed in service, it was found that the installation could not provide the amount of refrigeration required, because of the pressure loss in the 2-in. line. There was a drop of 3 psi between the evaporators and the compressor. The manager, looking for a scapegoat, blamed everyone but himself for the unsatisfactory results.

The capacity of a refrigerating compressor depends upon the amount of gas it can handle. This, in turn, varies with the condition and efficiency of the compressor and with the pressure at the suction inlet. Since the amount of gas entering the compressor varies approximately as the suction pressure, a unit operating at 30 psig will have almost 50 percent more capacity than when operating at 15 psig. A drop of 3 psi in the inlet pressure, therefore, results in a pronounced reduction in compressor capacity.

Friction Due to Elbows

When installing suction piping, including branch lines and headers, it is important that due consideration be given to the question of pressure loss. Too often, the pressure loss resulting from unnecessary changes in the direction of flow is not sufficiently taken into consideration. A 2-in. right angle elbow is equivalent in friction loss to 30 lineal feet of 2-in. pipe. Tees, 1 to 4 inches in size, equal 60 feet of pipe when evaluated in terms of loss due to gas friction.

Charts have been published showing the drop in gas pressure per 100 feet of pipe. Used in conjunction with tables showing the friction created by valves and fittings, expressed in equivalent feet of straight pipe, they are particularly useful in determining the size of suction pipe for any specific installation.

It is good practice to hold the velocity of the suction gas to values of less than 4000 fpm. Between 3400 and 3500 fpm gives good results. Although this calls for higher initial cost in pipe, fittings, and pipe covering, the higher initial cost is justified by the lower power consumption per ton of refrigeration.

Installation Procedures

The capacity of a pipe can be seriously reduced by carelessness in making a new installation. In the smaller sizes of pipe, erectors frequently use litharge and glycerine paste on the threads of both the pipe and the fitting. When the pipe is turned into the fitting, a ring of paste is formed at the end of the pipe. This paste can reduce the inner area of a pipe as much as 10 percent. By the time the system is placed in service, the ring will have hardened and a permanent restriction to the free flow of the liquid or gas is the consequence. Multiplied by several such joints, it is not difficult to understand how seriously the capacity of a pipeline can be restricted.

Still another cause of reduction in effective pipe area is the internal projection of metal around the periphery of the pipe, caused by a three-wheel pipe cutter. Although it is recommended practice to ream the end of the pipe to its normal cross-section, this operation is sometimes overlooked.

Connections between a suction header and a group of compressors are sometimes installed so as to cause trouble. In fact, the situation can be serious enough to result in damage to the compressors. A typical arrangement of the type referred to is shown in Fig. 1. This installation consisted of four compressors. Two were normally operated, with

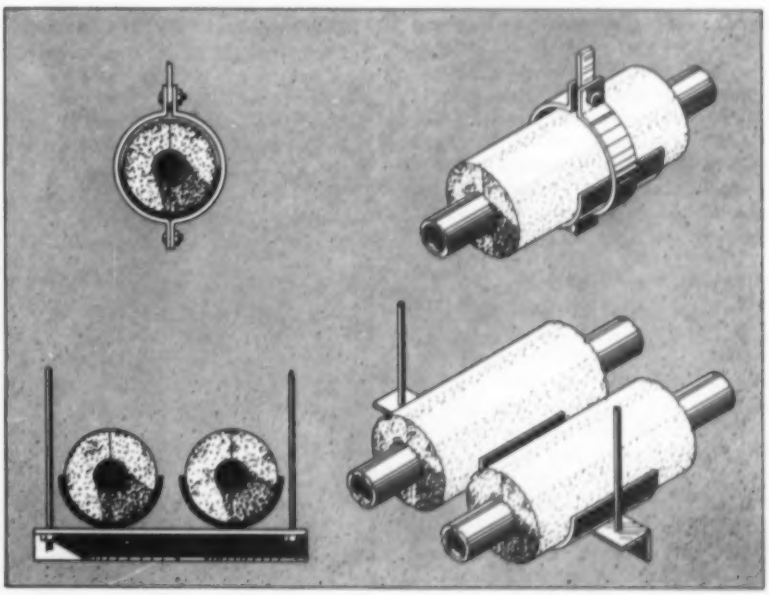


Fig. 4—Well designed pipe supports, of which there are several types, should go over protective saddles formed so as to prevent damage to pipe insulation.

TABLE 1 — MAXIMUM TONS REFRIGERATION ALLOWED FOR AMMONIA LIQUID LINES BETWEEN CONDENSER AND RECEIVER*

Pipe Size Inches	Maximum Tons
⅜	2.5
½	4.8
¾	14.0
1	24.0
1 ¼	50.0
1 ½	77.0
2	140.0

*Air Conditioning and Refrigeration Institute

a third unit being used to meet peak conditions. The suction pressure was 20 psig.

Suction to the compressors was taken from tees which faced downwards. This arrangement allowed liquid ammonia to collect in the inlet lines of the idle compressors. At times, the collection of ammonia represented several pounds of liquid. This required extreme care when starting the compressor so as to prevent damage to the suction and discharge valves. In fact, had the starting and stopping of these units been under automatic control, the slugs of liquid that entered the compressor would likely have caused serious damage.

In addition, there were no valves in the individual suction lines. If the suction stop valve at one of the compressors should leak, opening the compressor for maintenance would become a major operation.

Many of the shortcomings of this layout were eliminated by turning the tees upwards, as shown in Fig. 2. Angle stop valves were placed immediately above each tee. Sometimes a small diameter pipe extending from the dead end of the main suction line to the compressors is used to prevent accumulation of liquid in the header by draining it to one of the operating compressors.

Supporting the Piping

Those in charge of the design and construction of piping systems often overlook the necessity for providing adequate support for the suction lines. In one plant, for instance, a 3-in. main suction line between a liquid accumulator and a large ammonia compressor was supported from the ceiling joists with steel wire. Spacing between the wires was as much as 10 feet in some places. The weight of the pipe plus that of the pipe insulation caused it to sag sufficiently to form a liquid trap at the lowest point, as shown in Fig. 3. Besides the liquid trap, the use of wire presented the possibility that one or more of these make-shift hangers would break, allowing the pipe to fall or at least cause a leak in the flanged joints.

By following a few simple rules, the probability of having such accidents happen can be avoided. Hangers should be close enough together to prevent excessive deflection. Only approved types of hangers should be used, and they should be placed on the outside of protective saddles over the covering. See Fig. 4.

Liquid traps also can be formed by running the pipe around a steel or concrete beam or some other obstruction. Although such instances are rare, pipefitters that are untrained in refrigerating plant piping sometimes resort to very impractical schemes to get the work done. Experienced plant engineers know how to handle difficult piping problems—it is the person that proceeds with the confidence of ignorance that causes trouble.

Flange Bolts

Although most ammonia refrigerating piping systems are now being welded, there are still many pipe flanges used. It is important to remember that common bolts are not safe for flange work, since they do not possess sufficient strength to withstand the pressure and expansion that tends to pull flanged sections apart. Flange bolts should meet the ASTM standards. The best practice is to purchase them from the flange manufacturer when ordering the flanges.

Never use bolts that are too short to permit the full nut, and use bolts that are only slightly smaller in diameter than that of the bolt holes in the flange. Use good gaskets and pull the bolts just tight enough to insure a good joint. Tightening flange bolts to stop leaks when the trouble is an unsuitable gasket can stretch the bolts beyond safe limits.

Liquid Lines

It is important that the liquid lines be of ample size to deliver the amount of ammonia liquid required by the evaporators. If the lines are too small, serious pressure loss will occur between the receiver and the evaporators. This not only causes flashing of the liquid in the line, but also reduces the capacity of the evaporators. In addition, the compressor must handle a greater than normal percentage of gas that produces no refrigeration.

In one installation, for example, insufficiently sized liquid lines make it necessary to limit the amount of condensing water. Because 185 psig is needed to force enough ammonia to the freezing tank and cooling coils to meet the plant's refrigerating requirement, the supply of water to the two condensers must be regulated to hold the condensing pressure above this figure.

The liquid supply for this service is through a 65-ft long, ¾-in. pipe. Adding to the friction in this line are six, right angle elbows. If the liquid line were of ample size, the low temperature of the condensing water and the amount of cooling surface in the shell and tube condensers would permit carrying the condensing pressure at 150 psig.

Besides increasing power costs, the high condensing pressure reduces plant output. However, the plant owner obstinately refuses to increase the size of the liquid line. He contends that the pipe has been doing all right for a number of years and he sees no reason for changing the system.

An interesting comparison, showing the inefficiency of operation in this plant, is the difference in the amount of flash gas produced in the evaporator coils. At 150 psig condensing pressure and 20 psig evaporating pressure, the flash gas produced in passing through the expansion valve would be 15.6 percent of the liquid introduced to the evaporator. For the same suction pressure and 185 psig condensing pressure, the percentage of flash gas is 18 percent. This means that 18 percent of the liquid entering the evaporator does no useful work, yet it is handled by the compressor.

It is important that the liquid line between the condenser and the liquid receiver be large enough to ensure free drainage of liquid to the receiver as rapidly as the gas is condensed. There should be enough difference in elevation between the receiver and the condenser to ensure adequate fall. Table 1 provides recommendations for various ammonia system capacities.

The liquid outlet of all condensers should be fitted with a stop valve for use in emergencies. Valves on the liquid line and connections between the condenser and receiver should be placed in a horizontal position. This also applies to a valve placed on the inlet of the liquid receiver. This is necessary because the bonnets of valves in a vertical position act as reservoirs for the collection of gas. The gas, in turn, tends to hold back the free flow of liquid between the condenser and the receiver.

How To Select Control Switchboards

I&P EXCLUSIVE

ROY HOLLAND & FRANK NOLAN
Switchgear Department
Allis-Chalmers Manufacturing Company

Fig. 1 — Generator control panel and auxiliary bus panels installed in a small generating plant control room.

TODAY'S COMPLEX electrical systems are responsible for the development of the modern switchboard. The problem resolves itself into controlling, metering, protecting, and switching generating facilities and remotely located systems and equipment. The switchboards serving these needs fall into two general classes: control and power.

The power switchboard, once dominant, holds the main or primary circuit switching and interrupting devices, together with the associated interconnections. This type of board may also include protective and metering devices. Safety and other vital considerations have forced the installations of these boards to decline in number and to give way to the use of metal-clad switchgear.

The control switchboard, in contrast to the power switchboard, is finding increasing use throughout industry. A control switchboard mounts only control, metering, relaying, and associated auxiliary equipment. No main or primary circuits or devices are brought to this board. Control switchboards include vertical open panels, vertical enclosed panels, duplex panels, control desk boards, dual switchboards, benchboards, dual benchboards, and duplex benchboards.

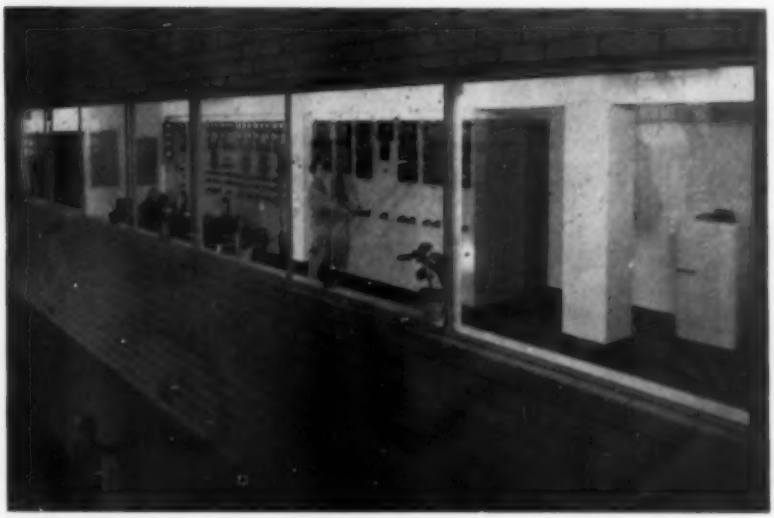


Fig. 2 — A balcony installed switchboard for control of four 5000 kw generators, with 15 kv air blast switchgear located on lower level below control room.

With all of the various types of control switchboards available, the question arises as to which type is best for a particular application. Factors like economy, ease of operation, safety, appearance, and compactness influence the selection, but no definite rule is available for any situation.

Vertical Panels

For the control of comparatively simple systems, like a small generating plant or battery-charging station, the vertical, enclosed panel, shown in Fig. 1, will usually be sufficient. The number of switches and meters is small enough so that the placing of these items on one vertical front panel does not make for confusion.

In some cases, a vertical open panel might be used. Today, open-type switchboards are mounted so that the rear of the panel is accessible only through a door at the end

of the panel, as shown in Fig. 2. In this particular arrangement, the multisection vertical open switchboard was placed on a balcony running around the generating room. The wall encloses the rear of the panel. (The words "open" and "enclosed" refer only to the back of the switchboard, and are not to be confused with the terms "live-front" and "dead-front" panels. All modern boards are of dead-front construction for safety. Another advantage to dead-front construction is the improved appearance.)

Fig. 3 — An interior view of a modern duplex control switchboard showing the walkway provided between the panels to give access to the internal wiring.

When a large number of circuits are to be controlled in a compact space, a problem faced by most utilities, the duplex panel is often the best answer. Instruments, indicating lights, and switches that should be under constant observation are mounted on the front panels. Items of secondary importance like watthour meters and relays are mounted on the back panel. A walkway is provided between the panels for access to the internal wiring, as shown in Fig. 3. The duplex panel also has advantages in complex control systems such as are associated with frequency changers, wind tunnels, and other such equipment.

Dual Switchboards

Large industrial plants pressed for space often use a dual switchboard. This is nothing more than two vertical metal panels placed back to back with only a small space (no walkway) between for access to the internal wiring.

Where frequent and fast switching of circuits is necessary, as in steel mills or some generating stations and transmission systems, a control desk (Fig. 4) offers an effective solution to the problem. The equipment on a control desk could also be mounted on a vertical, enclosed panel or on the front of a duplex or dual switchboard. But the use of the desk facilitates recogni-

Fig. 4 — Graphic panel controls all coal handling at Shawnee Steam Station. Barge docks, car dumpers, storage piles, boiler hoppers, and interconnecting conveyors are shown on board. Through windows, operator can see most of the system.

tion of the mimic buses and control switches.

The dual benchboard in Fig. 5 is simply a refinement of the control desk in Fig. 4.

The reason for specifying dual or duplex is usually based on the desirability of a particular construction type or on availability of space. These types of benchboards have been used very successfully in the control of small generating stations.

No Rules

The location of the various items on a switchboard is usually specified with no industry standards or rules being followed. Most utilities and some industrial plants have set up certain standards for their own systems. Utilities also specify that a metering cubicle must be included in the layout of its customers' switchboards or switchgear.

Symmetry

Each switchboard user may have very definite ideas as to the arrangement of instruments and relays on any one panel for the control of a particular circuit. No one, especially operating personnel, wants instruments and relays mounted just any place without regard to circuit symmetry. Therefore, the instruments for any one circuit should be grouped together with their control and instrument switches. On a duplex switchboard the relays, watthour meter, and controls, would be mounted on a panel opposite to that mounting the corresponding control equipment. This promotes ease of operation and saves wire.

A factor to be considered in the design of switchboards is that instrument manufacturers in the past few years have decreased the size of indicating instruments, while improving their readability. This conserves panel space without sacrificing accuracy.

On the other hand, protective relaying has become more complicated, calling for more relays—and physically larger relays. Often, the best switchboard design puts control switches and indicating lamps on a control desk. The indicating instruments are then mounted on an enclosed switchboard, arranged so that the instrument board is in direct view of the operator while he is engaged at the control desk (Fig. 6). The protective relays are then mounted on a duplex enclosure and located in an entirely separate room, accessible for maintenance and testing. These arrangements involve more cost in additional wiring runs for interconnections to the various switchboards. However, the savings in building area resulting from this type of design more than offset this additional expenditure.

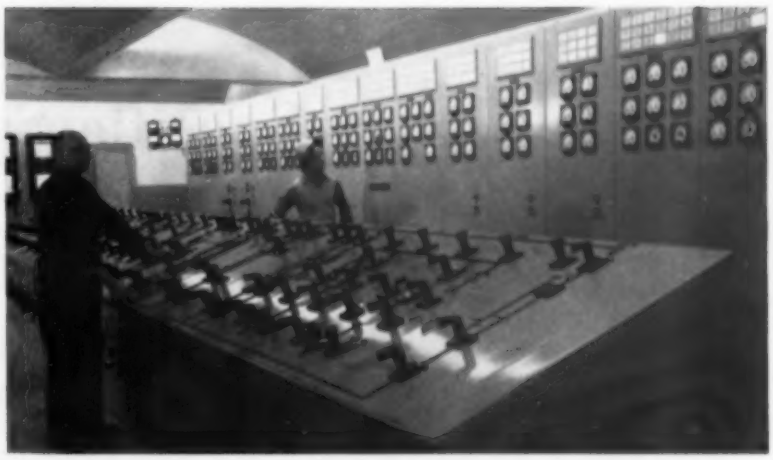


Fig. 6 — A more complicated relaying system consisting of a desk with instruments on a separate enclosed switchboard in full view of the operator.

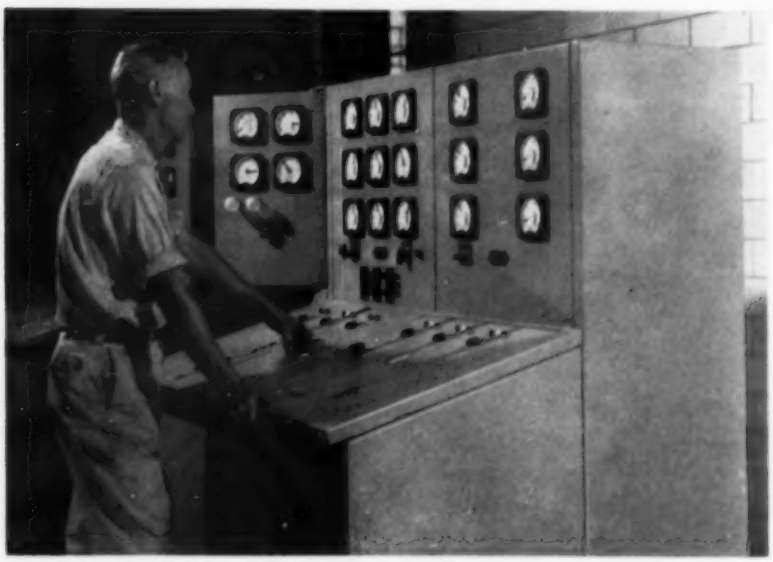


Fig. 5 — This dual benchboard is merely a refinement of the desk type of switchboard and is particularly suitable for use in small generating stations.

Planning

Control switchboards are factory assembled and can be shipped ready to operate. However, experience has shown that, in many instances, no provisions have been made in building layouts for the entrance of the switchboard equipment. This forces shipment of switchboards in more than one section, requiring that all inter-panel wiring be disconnected at the break and then re-connected upon installation. This can become a rather expensive oversight. Much consideration should be given in building planning to the installation of future switchboard equipment.

The connections to the switchboards are made very easily at the bottom of a vertical wiring trough. When future expansions are made, duplicate units can be fitted to existing units, keeping a uniform appearance. Today's control switchboards are practical, efficient and pleasing in appearance, and are proving to be the solution to many types of control problems.

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Specific Speed Chart For

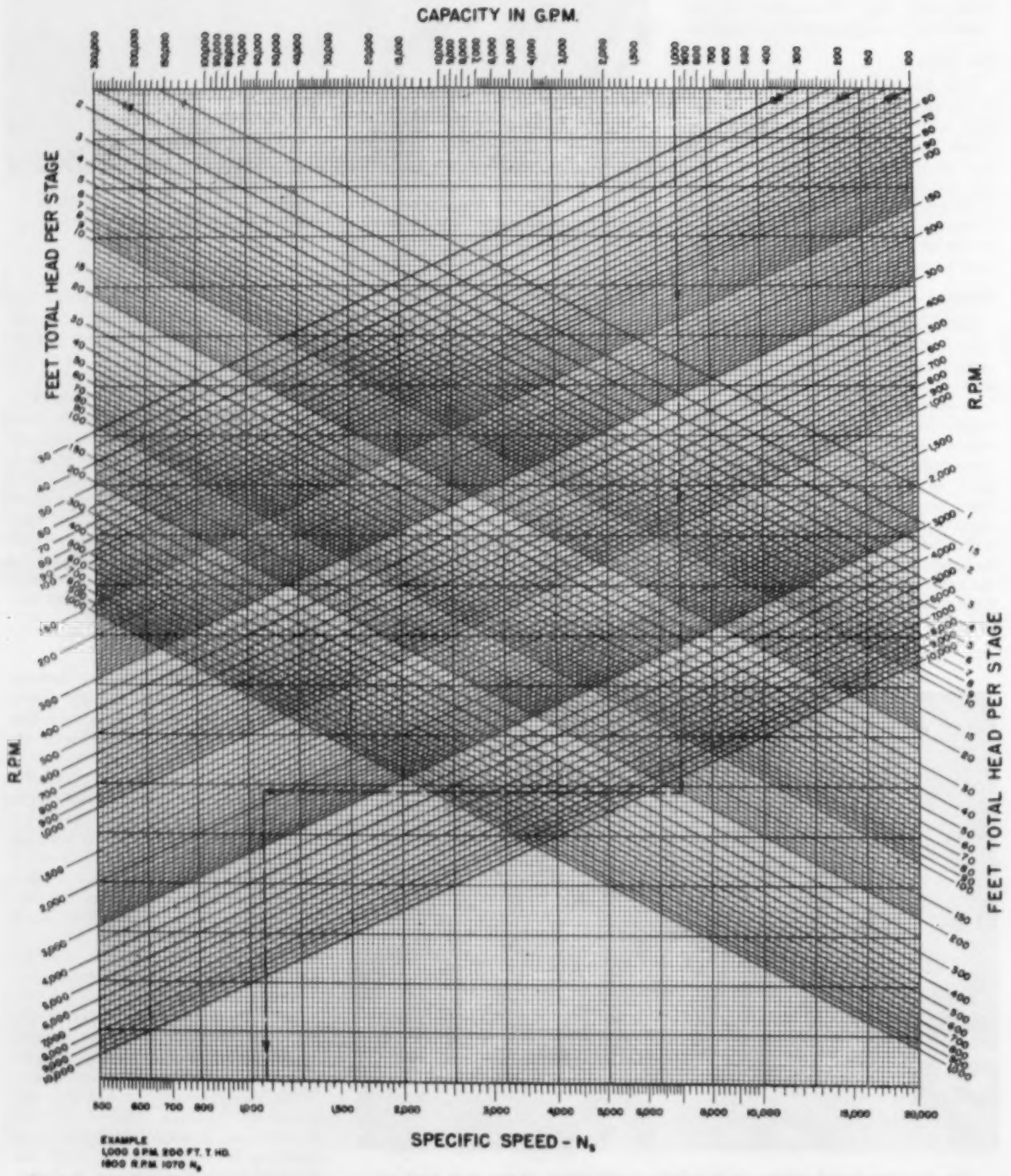

Fig. 1—Using capacity, head, and speed, graph can be used to determine specific speed, which is an index number.

Centrifugal Pumps

Need to calculate Specific Speed accurately — and in a hurry? This chart makes it a simple job to select the right centrifugal pump and predict its performance characteristics.

ROY CARTER and IGOR J. KARASSIK
Centrifugal Pump Division
Worthington Corporation

THE PROGRESS achieved in the science of hydrodynamics may be directly credited to the almost universal application of model study, which precludes the necessity of experimenting upon full size commercial constructions which are too expensive and inconvenient. Historically, the honor of introducing the mathematical background for model investigations must fall to Newton who, in 1687, evolved the theory of dynamic similarity.

The application of this Newtonian principle has since given rise to the wide use of models in investigation of hydraulic machinery as well as in other fields of science. One application of the principle of model and prototype relationship has enabled engineers to predict the performance of a centrifugal pump on the basis of the behavior of other pumps, smaller or larger in size, operating over a wide range of design conditions but modeled from and like each other.

Similarity Principle

The principle of dynamic similarity states that two pumps geometrically similar to each other will have similar performance characteristics. In order to afford some basis of comparison between various types of centrifugal machines, it became necessary to evolve a concept linking the three main factors of performance characteristics (capacity, head, and rotative speed) into a single term. The term "specific speed" is such a concept. In its basic form, the specific speed is a nondimensional index number which is numerically equal to the rotative speed at which an exact theoretical model would have to operate in order to deliver one unit of capacity against one unit of total head. It is mathematically expressed as:

$$N_s = \frac{n\sqrt{Q}}{(gH)^{3/4}}$$

where N_s is the specific speed
n is the rotative speed
Q is the capacity
H is the head (head per stage for a multistage pump)
g constant

In order for this relationship to remain dimensionless, when using English units, the rotative speed would have to be expressed in revolutions per second, the capacity in cubic feet per second, and the head in foot-lbs per lb or feet. However, since specific speed is used strictly as an index number, certain liberties are permissible in selecting the units used. Thus, the gravitational constant "g" is omitted, leaving

$$N_s = \frac{n\sqrt{Q}}{H^{3/4}}$$

The rotative speed is expressed in revolutions per minute. For some years, two units of capacity, gallons per minute and cubic feet per second were used in the United States to determine specific speed, but the gpm basis has been accepted as standard by the Hydraulic Institute and is now the approved basis. The unit of head is the foot.

It should be mentioned that the formula for specific speed remains unchanged regardless of whether a single suction or a double suction impeller is involved. It is customary, therefore, when listing a definite value of specific speed, to state which type of impeller is involved.

Operating Specific Speed

The customary presentation of the performance characteristics of a centrifugal pump consists in plotting its head, power consumption, and efficiency as ordinates against the pump capacity as abscissae at a constant rotative speed. Since the pump speed, capacity, and head all enter into the concept of specific speed, it is also possible to calculate the specific speed for any given operating condition of head and capacity, and plot this operating specific speed against the pump capacity. For example, Fig. 2 shows the performance characteristics of a 6 in. pump, operating at 1760 rpm, whose maximum efficiency is 1480 gpm at 132 ft head. The operating specific speed curve has been added to the usual performance curve. The operating specific speed is zero at zero flow and increases with the capacity until it reaches infinity at the maximum capacity of 2270 gpm and zero head.

Type Specific Speed

The type specific speed, by definition, is the operating specific speed that gives the maximum efficiency for that particular pump and becomes an index number identifying the pump type. It should be noted that this index number is independent of the rotative speed at which

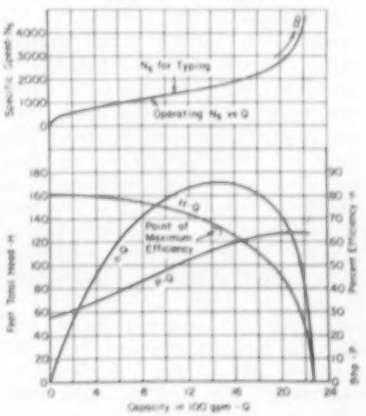

Fig. 2—Graph shows performance characteristics of a 6 in. pump.

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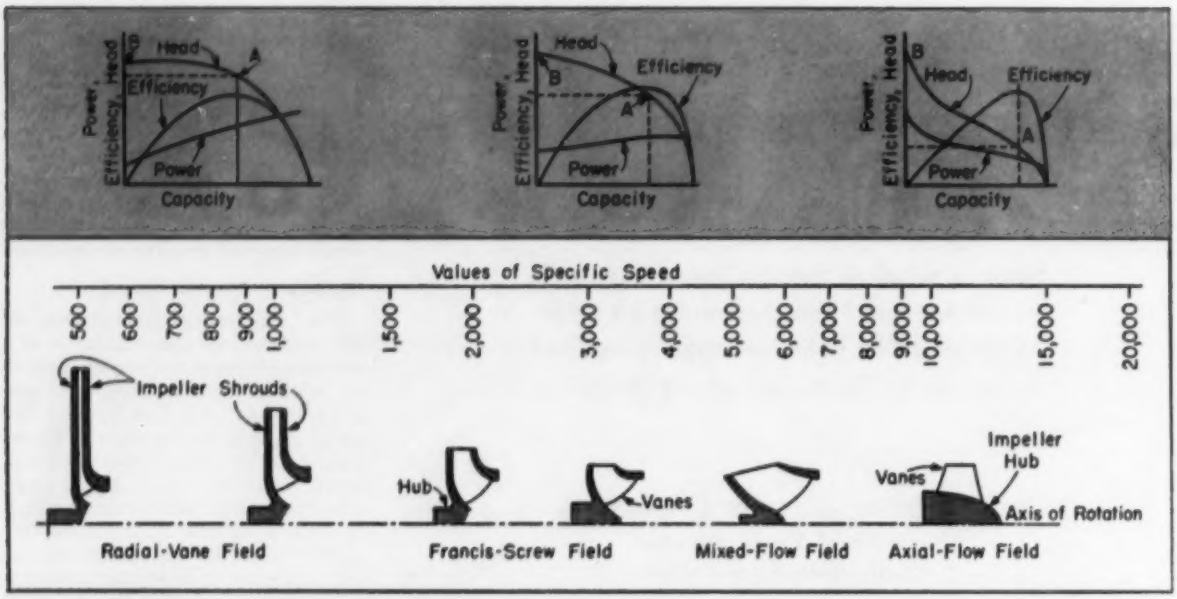

Fig. 3—Some typical impeller outlines are shown here with their specific speeds and performance characteristics.

the pump is operated, since any change in speed carries with it a change in capacity in direct proportion, and a change in head varying as the square of the speed.

Normally, the conditions of service for which a pump is sold are relatively close to the maximum efficiency point, and the specific speed determined from the conditions of service will be a close indication of the pump type.

While the calculation of the formula for the specific speed of any given pump can be carried out on a slide rule, even experienced men can easily make errors in such slide rule calculations.

Graphical Solution

In order to avoid such calculations, a chart (Fig. 1) has been drawn to make possible the solving of the formula for specific speed graphically. To determine the specific speed knowing the capacity, head, and speed, project vertically from the capacity scale to the head line, then horizontally to the rpm line, and finally vertically downward to the specific speed scale. For example, if it is desired to establish the specific speed of a pump designed to deliver 1000 gpm against a total head of 200 feet when operating at 1800 rpm, project vertically from 1000 gpm to the intersection with the diagonal 200 ft line, then horizontally to the 1800 rpm line, and vertically to the specific speed scale, reading $N_s = 1070$. Reverse these steps to determine the capacity when specific speed, rpm, and head are known. To determine the rpm when the capacity, head, and specific speed are known, project from the capacity scale to the head line, then project horizontally to a point directly over the specific speed and note the corresponding speed in rpm.

Significance of the Concept

The most important application of the specific speed concept is in the fact that all sizes of pumps can be indexed by the rotative speed of their unit capacity—unit head model. Thus, the specific speed concept can be used in such a manner that for homologous designs, the performance of any impeller of the series can be predicted from the knowledge of the performance of any other impeller of the series. Because the physical characteristics and the general outline of impeller profiles is intimately connected to their specific speeds index, the value of the index number can immediately evoke in the mind of the engineer the approximate impeller shape in question. As an illustration of this statement, Fig. 3 represents a few typical impeller outlines tied down to their specific speeds.

The specific speed of a given pump will also reflect in the shape of the pump performance characteristics, and while some variation in the shape of these curves can be obtained in the design of the impeller and casing water ways, the variation that can be obtained without adversely affecting the pump efficiency is relatively small. Approximate characteristics for the impeller types shown in Fig. 3 are shown over their specific speeds.

Low type specific speed impellers have a lower maximum efficiency than medium type specific speed impellers. This is basically due to the fact that the low type have considerably more disc area for a given set of operating conditions and hence a greater loss in disc-horsepower. High specific speed types also have a lower maximum efficiency than the medium specific speed types because, while they have still further reduced areas and therefore still lower disc-horsepower losses, they give poor flow conditions.

Important Application

A final and very important application of the specific speed concept is its effect on the permissible and recommended suction conditions. Slightly over twenty years ago, the Hydraulic Institute sponsored the assembling of available data on centrifugal pumps in which cavitation troubles had been experienced. These studies finally permitted the plotting of a series of charts showing, not the best or the most suitable, but the maximum specific speed for which experience has shown a centrifugal pump can be designed with assurance of a reasonable and proper operation for any combination of conditions. These charts are commonly known among centrifugal pump engineers and users as Specific Speed Limit Charts.

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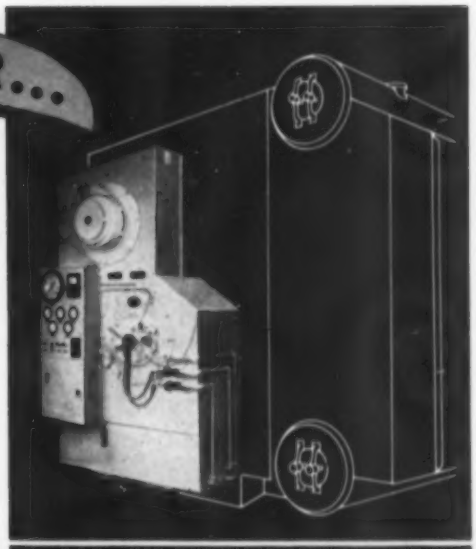

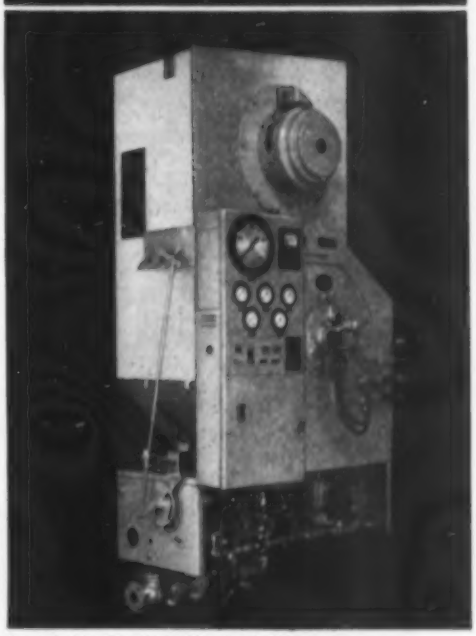

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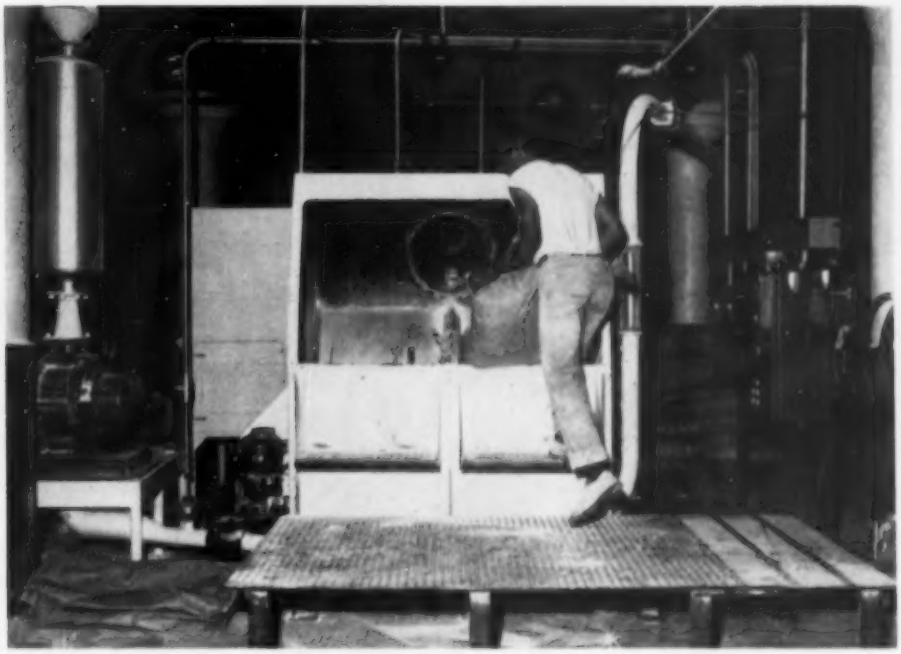


Fig. 1—Flour is emptied into bag-dump hopper with blower at left and controls at right.

New Installation Caps Ward's Ten Year's Experience With

Pneumatic Bulk Handling

P. R. INGLIS
Chief Engineer, Ward Baking Company

IN 1945, The Ward Baking Company developed its first pneumatic handling system at its New York bakery and has since installed improved systems in its other bakeries. The most recent installation is the "Airveyor" system at the Newark plant. The Newark system pneumatically delivers flour from a bag dump hopper in the basement to storage bins on the first floor and then to dough mixers on the fifth floor at the rate of approximately 200 pounds per minute.

With the old system, flour was dumped into hoppers and conveyed by screw conveyors to a large wooden storage bin. From this bin it was carried by a second screw conveyor to a bucket elevator that discharged to a third screw conveyor for distribution to scales located above the dough mixers.

With this system, flour could collect in dead spaces or on structural obstructions, and the entire system had to be dismantled to expose these points for cleaning. Flour could also escape from enclosures and cover nearby areas with a thin white coating. These limitations necessitated bi-weekly cleanings to remove the coating and to clean surrounding work areas. This usually was done on Saturday and required four mechanics and 12 porters to completely dismantle, scrape down, and clean the entire system.

Self-cleaning System

The Airveyor system, engineered and built by the Fuller Company, Catasauqua, Pa., is entirely self-cleaning and has eliminated completely the "field days" associated with the old system. Not only is the system self-cleaning, but special efforts have been made to prevent dust collection on exterior members of the system. For example, structural members are of round piping, rather than the customary angular shapes.

Flour arrives at Newark in bags which are emptied into a bag dump hopper shown in Fig. 1. The bag dump is divided into two sections, each having a discharge aperture which can be regulated to permit flours to be mixed in ratios of up to one in ten. A positive pressure Roots type blower supplies the airflow that propels the flour once it passes through an airlock into the conveying line. Storage-bin level-indicators signal the bag dump location when bins are low and automatically shuts down the blower should the high-level point be reached.

Route of Flour

From the bag dump, flour is blown to a cyclone and then discharged into a sifter (Fig. 2). Exhaust air from the cyclone passes through a dust collector before going to atmosphere. Flour from the sifter passes through a centrifugal entoleter to remove infestation, then through an airlock to

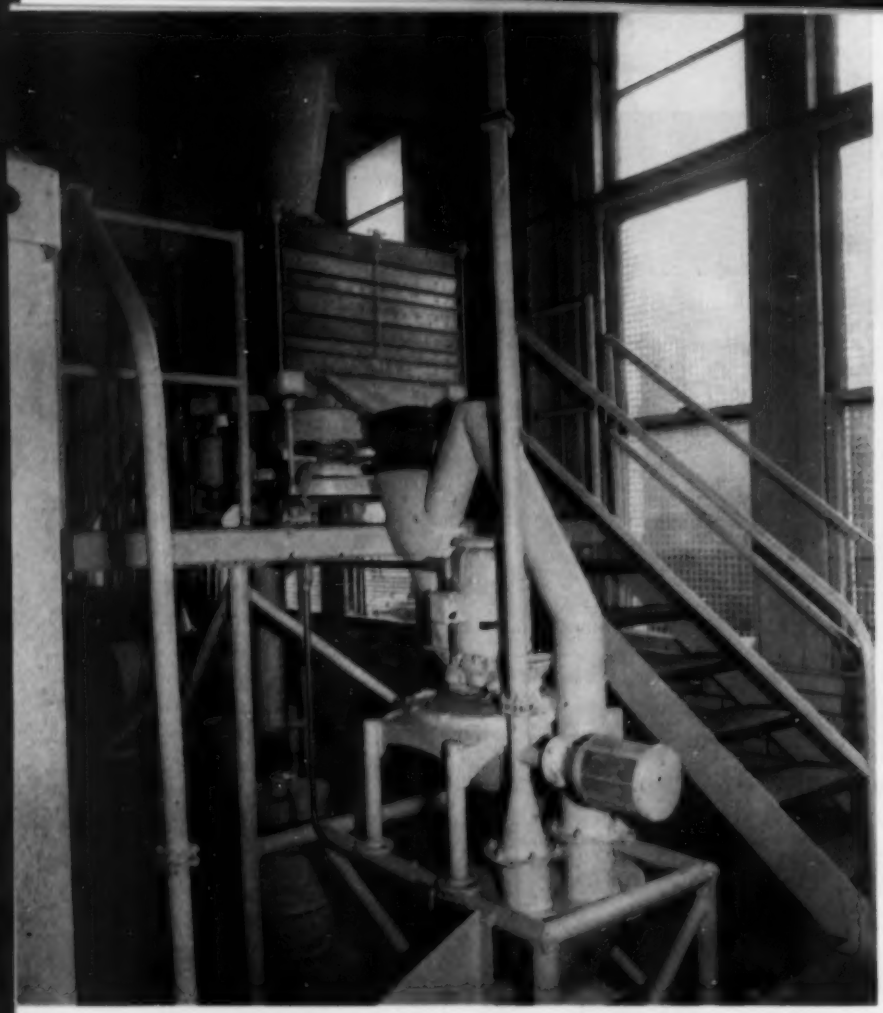


Fig. 2—Flour is delivered via a cyclone into sifter, and then to an entoleter.

a transport line leading to a steel storage bin (Fig. 3). A Roto-Clone above the bin draws off exhaust air and delivers it to the dust collector for filtering.

Storage Bin

The storage bin has two drainage points (Fig. 4), each of which services three dough mixers. When the operator at the dough mixers needs flour he pushes a button that automatically starts a blower to create the airflow for carrying flour to the mixers (Fig. 5). The switch simultaneously starts up a motor that operates the rotary airlock through which flour discharges from the bin to the pneumatic line (Fig. 6, front), and a small blower supplying air to an "Airslide" at the base of the bin for keeping flour flowing to the airlock (Fig. 6, center).

Airslide Duct

This Airslide comprises a rectangular plenum duct beneath the bin, the top of which is covered with a fabric of special permeability. Air forced into the plenum chamber passes through the fabric and into the bin, "fluidizing" the flour that rests upon it, causing it to flow by

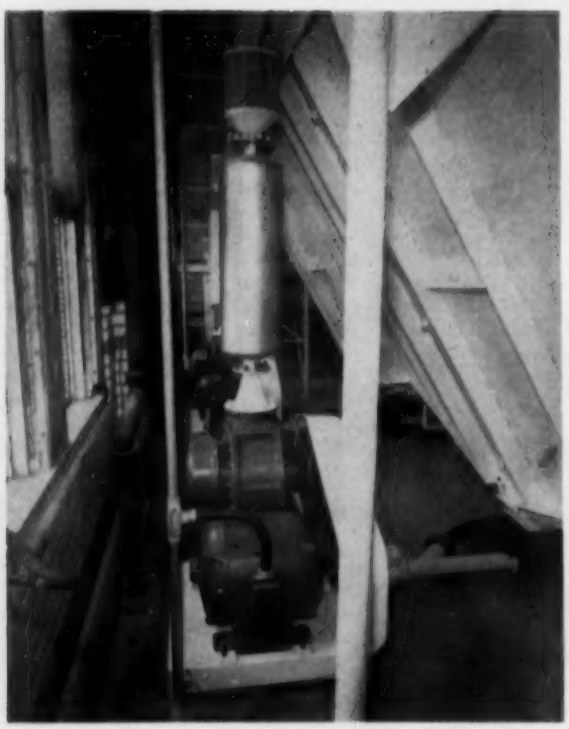


Fig. 5—Left. Airlock bypass at right enables system to finish weighing with a dribble stream for more accuracy.

Fig. 6—Below. Motor (front) operates rotary airlock, and blower (center) supplies air to airslide bin-bottoms.

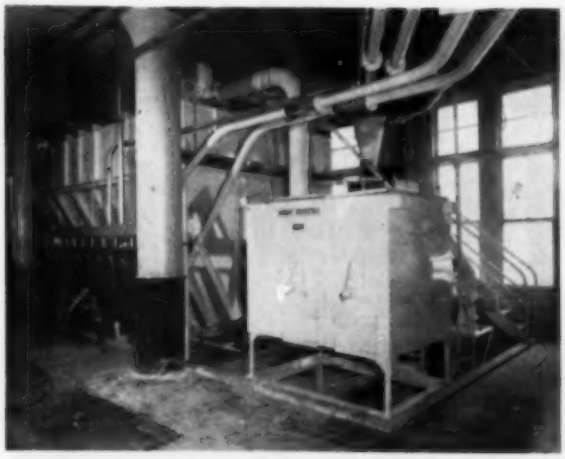


Fig. 3—The eighty-thousand pound capacity "Airslide" type storage bin with dust collector in foreground.

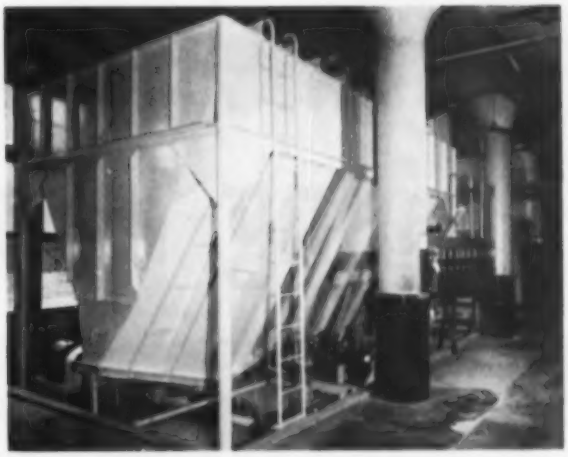


Fig. 4—Bin has two run-offs, each serving three dough mixers. "Airslide" ducts feed flour into airlocks.

gravity into the rotary airlock.

Flour is thus blown from the bin into individual weigh hoppers situated above dough mixers on the fifth floor (Fig. 7). The weight of the flour required for any one batch is selected by the operator who sets the scale beam poise before pushing the delivery button. The flow of flour automatically cuts off when this preset weight has been delivered to the hopper. To achieve a maximum degree of accuracy, the last few pounds are dribbled into the hopper, with the storage bin airlock still turning but with part of the air being automatically shunted around it. This airlock by-pass can be seen in Fig. 5. As soon as full weight has been reached, the airlock stops the feed into the transport line and the unwanted amount of flour in transit is blown back into the storage bin. The mixer operator empties the scale hopper into the dough mixer by push button control.

Line to Bins

The transport line from each bin dump passes the three hoppers it services and is connected with each by a branch line and valve. If all three valves are closed, the flour loops back to the storage bin, and when the line is clean the blower shuts down. Exhaust air from the scale hoppers is filtered through a dust collector (Fig. 8). Provisions have been made for tapping off dusting flour by means of a Roto-Clone hopper located on an upper floor.

Ward has found that in addition to improving sanitary conditions and eliminating dismantling and clean-up requirements (Newark saves over 200 work-hours per month), the pneumatic system offers other advantages. For example, loss of flour through breakage and leakage has been reduced substantially and it is believed that the additional aeration received by the flour tends to improve the texture of the finished product as well.

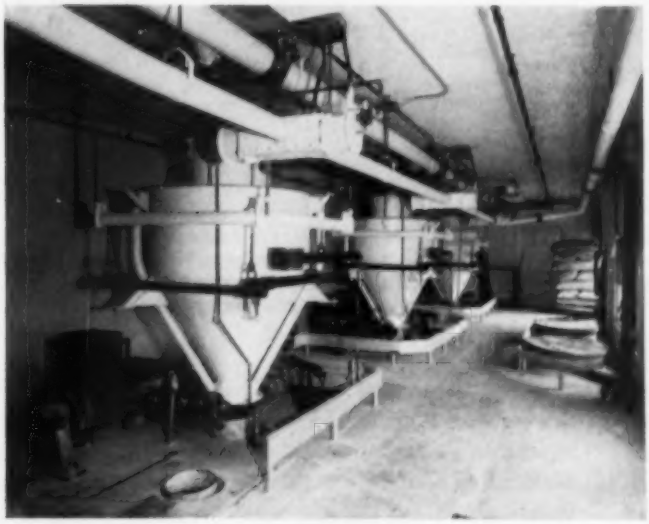
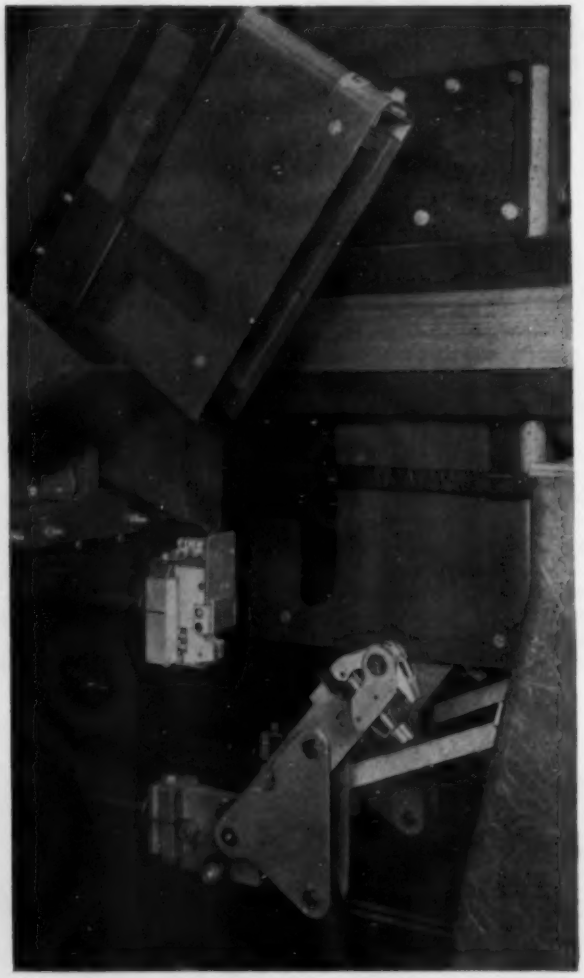


Fig. 7—When correct weight has been delivered to these weigh hoppers, intake closes, line is blown out, blower shuts off.

Fig. 8—Weigh hopper dust collector and conical hopper save flour for "dusting" purposes.

Come to the plant and going into I-T-E Metal-

1. Horizontal drawout design. Even heavy 15 kv circuit breakers, such as this one, roll out easily on permanently attached wheels. Breaker compartment is full-depth, one-piece welded frame, retains shape, permits lifting as a unit.



2. Positive arc interruption. On 15 kv breakers, double-coil, closed-iron magnetic blowout circuit draws arc rapidly into overhead quenching chute. Pivoting arc chutes, shown above, facilitate maintenance. Note sturdy contact assembly.

Discover in these pictures just a few of the extra-value, quality features in all I-T-E Metal-Clad Switchgear. They were taken right here in the I-T-E plant and show the equipment in process of manufacture.

If you're planning new construction where you will need metal-clad switchgear, take a tip that can help you make the very most of your investment dollar: Visit the I-T-E plant here in Philadelphia. See the quality features actually being built into the equipment—quality that keeps I-T-E Switchgear performing more safely and dependably all the years it serves you. See the scenes shown on these pages, plus dozens more like them. See the extra value in I-T-E Switchgear that you won't find in any other

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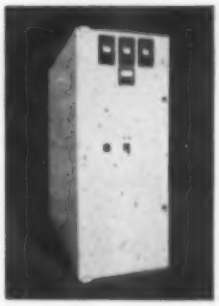
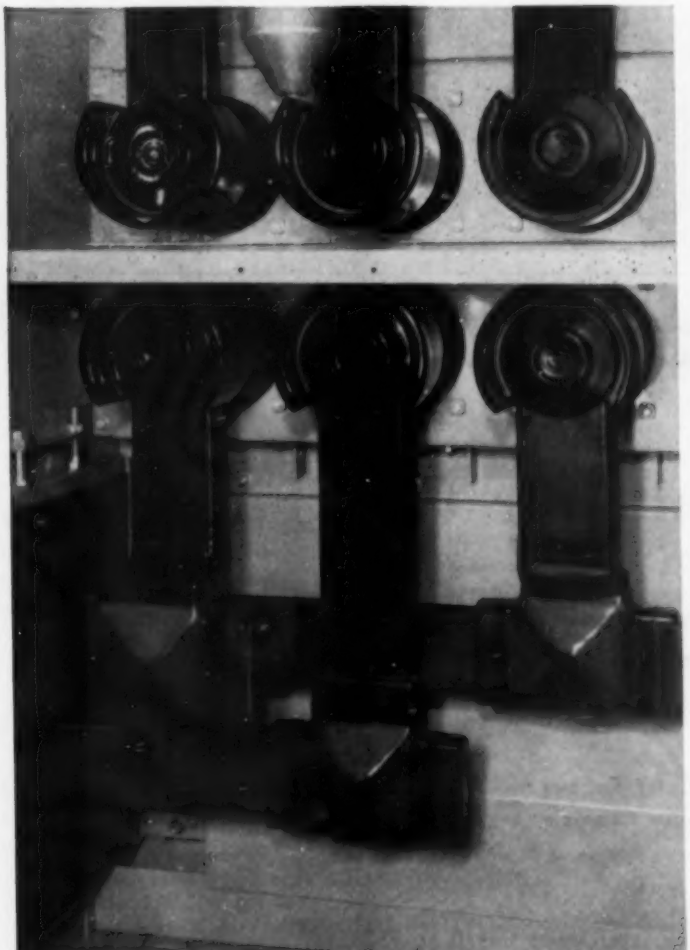
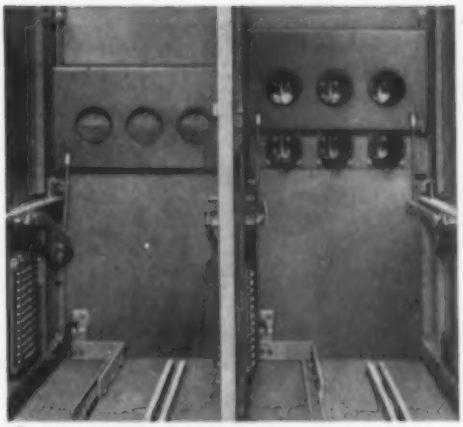
see the extra value Clad Switchgear





3. Bus rigidly braced, heavily insulated. View into rear of 15 kv compartment shows porcelain disconnect bushings and bus supports which insulate and hold the bus in alignment during short circuit stresses. Steel paneling throughout forms isolated compartments.



4. Superior isolation of compartments. Gravity-type shutters, shown closed at left and blocked open at right, isolate primary terminals from breaker compartment.

5. Fine, durable finish. All panels and doors are sanded, bonderized and cleaned with spirits, then painted with three coats of enamel—baked on and rubbed down.

make. I-T-E Metal-Clad Switchgear is available in ratings through 13.8 kv, 500 mva.

For details, contact the I-T-E field office nearest you. Look in your classified directory under "Electric Equipment." I-T-E Circuit Breaker Company, Switchgear Division, 19th and Hamilton Sts., Philadelphia 30, Pa.

I-T-E
CIRCUIT BREAKER COMPANY
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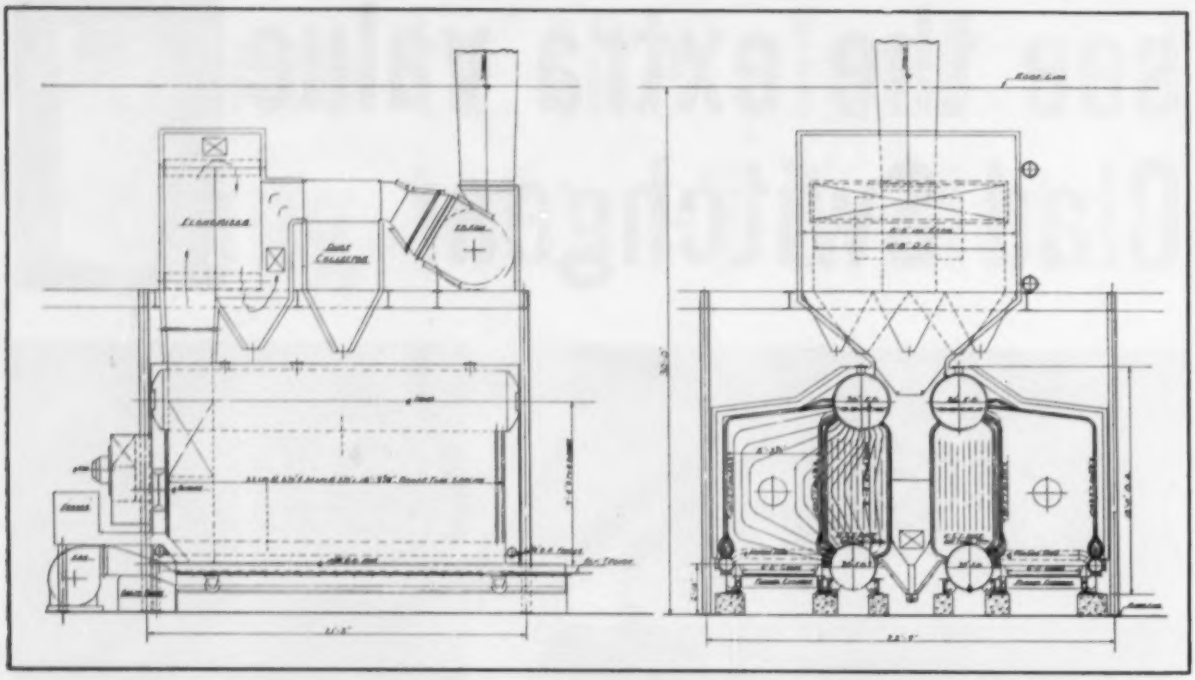


"Two-package" steam generators are a new Springfield development to meet growing demands for large capacity assemblies.

Packaged Units for Coal Firing

I&P EXCLUSIVE

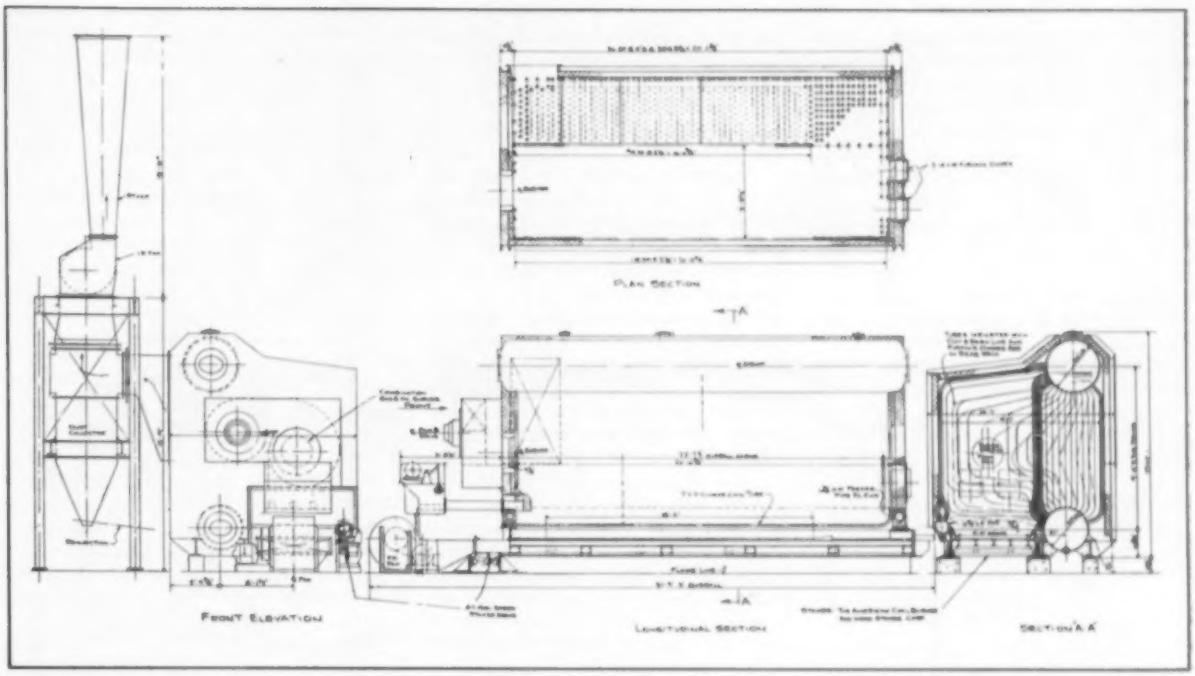
Now you can buy a packaged water tube boiler built to burn coal or solid by-products as well as gas or oil.

G. A. REHM, Chief Engineer
Springfield Boiler Company

Mr. Rehm graduated from Badiaches Staats Technikum, Karlsruhe, Baden, receiving his degree in mechanical engineering in 1923. Prior to this period of formal education he also served two years apprenticeship in a boiler and locomotive factory and completed his master mechanic examination. He emigrated to the USA in 1926, and became a naturalized citizen in 1932, at Philadelphia, Pa. Mr. Rehm was affiliated with Badenhausen Corporation from 1926 to 1931, and when that company was purchased by Riley Stoker Corporation he was transferred to Worcester as Assistant Chief Engineer in the newly created boiler division. From 1931 to 1947, he was Assistant Chief Mechanical Engineer of Riley Stoker Corp., with responsibility for all designs and detail drawings, proposal drafting and development, field assembly (erection) standards, testing standards, and special developments. In November 1947, he became Chief Engineer of Springfield Boiler Co. He is the inventor and co-inventor of some 30 patents in the power boiler field, issued by the U.S. Patent Office, and he is a registered professional engineer in six states.

EARLY IN 1948, Springfield Boiler placed in operation its first shop assembled packaged boiler. At that time a shop assembled water tube steam generator was a new concept in the field of steam generation. Only one other major boiler manufacturer had developed a packaged water tube unit. Today packaged steam generators are widely accepted by the Government and industry alike. Nearly every water tube boiler manufacturer has its line of packaged boilers.

Numerous factors have contributed to this acceptance of packaged water tube boilers. Shop assembled units provide a coordinated engineering design, in a wide range of capacities, for service conditions up to 900 psig pressure. They can be furnished with integral superheaters for total temperatures up to 830 F, and if project requirements dictate,



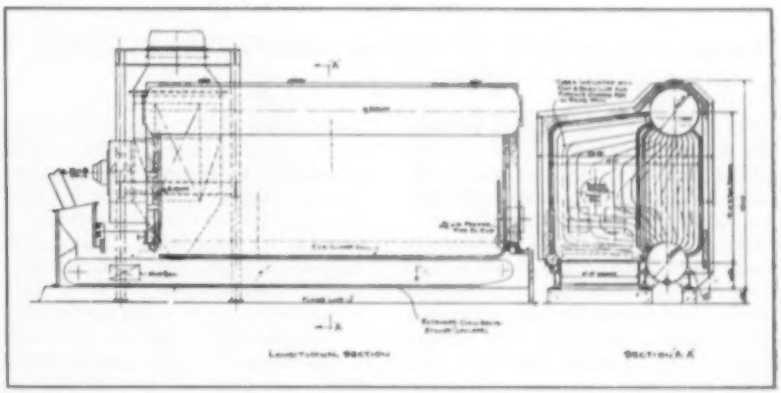
Drawing shows typical shop assembled boiler with reciprocating grate stoker for firing coal in combination with gas or oil.

with companion packaged heat recovery equipment. Since installation costs are a minimum, the overall investment per unit of capacity is appreciably lower for packaged units than for comparable field erected designs. Plants with large loads can install a multiple number of boilers to obtain extremely flexible operation and high efficiency.

Design Trends

For the manufacturers, the trend to packaged boilers has meant an intense effort to produce designs that will provide high availability with low maintenance. Currently, developments are being influenced by demands for larger capacities in single units and for assemblies to meet such specialized applications as incineration and steam generation using refuse or by-product fuels. Even more important, manufacturers recognize the necessity of utilizing coal, the nation's most abundant mineral fuel, and of producing equipment for high pressure—high temperature hot water service.

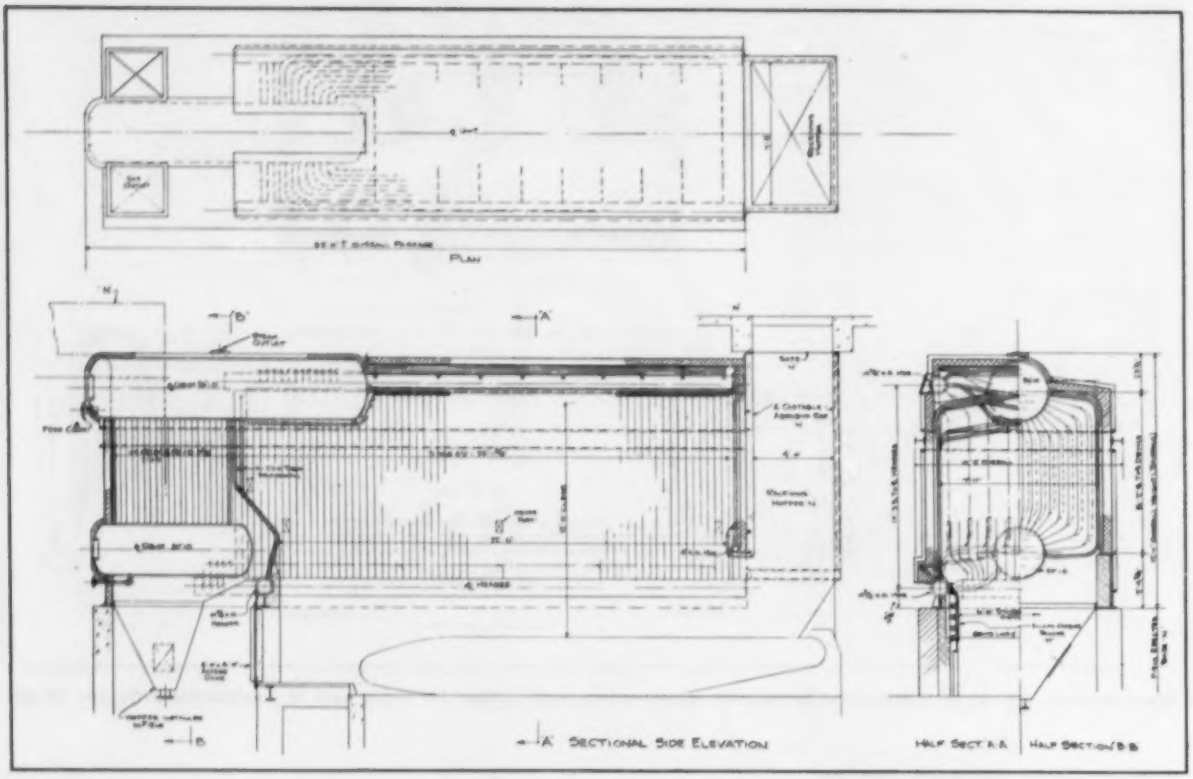
With any preassembled item overall physical dimensions are controlled by shipping restrictions. Working within these limitations, primary concern in packaged boiler design is to provide proper furnace volume for effective combustion. Springfield, and a number of other manufacturers, have found that the vertical two drum unit with a series of continuous tubes forming the roof, side walls, and floor of the furnace has many advantages for steam service with liquid and gaseous fuels. By proportionately varying both the front profile and the depth, and using water cooled front and rear walls, very satisfactory furnace design can be obtained.



Longitudinal and cross-sectional views illustrate a standard packaged unit similar to the one shown directly above, but with a stoker of the extended chain grate type.

Vertical two drum units also provide certain circulatory advantages and good water level stability. Some designers feel circulating tube velocities should be at least 8 fps to obtain an effective scouring action and to prevent tube deposits. One installation, having a heat release of 65,000 Btu per cu ft of furnace volume per hr, can be cited as evidence of the advantage of this concept. On this job the water conditions were extremely poor, yet no irregularities were noted until several failures occurred near the entrance of the bottom row of tubes into the lower drum. Upon opening the unit for inspection it was found that sludge and sediment had built up in the lower drum to a point where it had blocked off several of the bottom row of tubes, and this ultimately caused their failure. The remaining tubes, however, were clean.

Since other steam generating facilities were available, there was no urgent need to repair the damage,



Packaged steam generators of this type were especially designed for burning refuse, garbage, solid by-products, or coal.

and the boiler was allowed to stand for several days before tube replacement was attempted. At this point added complications developed. The unit's setting, arranged for pressurized firing, had retained the leakage and condensate in the furnace, and external corrosion of the tubes and drums had begun. Deterioration had progressed to an extent that far exceeded the damage caused by the tube failures.

To prevent similar occurrences, Springfield boilers now include additional pressure-tight space under the furnace floor, equipped with automatic emptying, water sealed drainpots or drain plugs that can be used to remove moisture during outages of the boilers. These plugs also permit periodic checks on possible fireside leakage during operation. As a further aid to maintenance, the setting design incorporates a double steel casing for the side walls and roof. Each panel is fully insulated and can be removed and replaced as a unit. The danger of condensation and corrosion at low loads has been removed by baffling which guides the gases over the low level heating surfaces at all loads.

A most promising approach to larger capacities in single units has been in the use of tangent tubes on units for oil and gas firing and in provisions to assure maximum gas contact with all of the available surface. Another entirely new development is the combining of two separate assemblies, each with a rating up to 45,000 lb per hr, to provide capacities up to 90,000 lb per hr with a "two-package" shipment. Also new is the development of units for firing waste products or for serving as steam producing incinerators. All of these designs utilize standard surface arrangements pioneered previously in field erected boilers.

Coal Firing

Added impetus to the demands for coal fired equipment also has developed since the Navy Department issued specifications covering coal fired packaged boilers. These specifications limit transfer through heating surfaces to 8360 Btu per sq ft per hr and heat release rates to 35,000 Btu per cu ft of furnace volume per hr and 750,000 Btu per sq ft of grate area per hr. This probably will hold single unit capacities for Navy specification boilers to approximately 30,000 lb per hr. However, design practices for industrial units will be based on the manufacturer's experience, and higher capacities can be expected by the use of much higher furnace heat release rates and higher heat absorbing rates of the heating surfaces.

In investigating the coal fired packaged boiler, practically all of the well known types of stokers appear to offer possibilities depending on the service requirements. The principal changes from the standard vertical two drum unit will be the elimination of floor tubes, the incorporation of a water wall header on the outside wall, and the insertion of a clinker chill tube adjacent to the drum. Furnace wall tubes will be refractory backed, and the refractory will be carried up over part of the furnace surface to meet the demands of coal firing. Most efforts will be directed at obtaining continuous ash discharge and automatic ash removal to minimize labor.

Engineers are familiar with the design details of both the traveling grate type continuous ash discharge spreader stoker and the chain grate stoker. Both provide certain desirable features depending on the fuel available and the load characteristics. Where project conditions will permit periodic ash removal, underfeed and power dumping type

spreader stokers can be considered. Much attention also is being given to various types of vibrating grate stokers, particularly because some designers want to include provisions for multiple fuel firing. In fact several of the accompanying illustrations showing stoker fired units have an oil or gas burner inserted above the stoker. With these combination firing arrangements, the feeding and grate drive mechanisms are retracted from the front wall to allow space for the burner above the fuel hopper.

Vibrating Stokers

One type of reciprocating grate utilizes an impact principle to momentarily stop the grate at timed intervals. With this assembly the entire grate is mounted on a chassis equipped with grooved or flanged wheels that can move freely on rails fixed to the foundation. The variable movement of the chassis is accomplished through a motor driven gear reducer with a special arrangement to allow for quick momentary stops. This will permit the fuel bed to be moved by inertia and air jet propulsion to the ash discharge. This arrangement offers the advantage of periodically jarring the fuel bed, thus tending to prevent caking. The grate is of the forced draft nonsifting type, while the chassis itself also forms the plenum chamber.

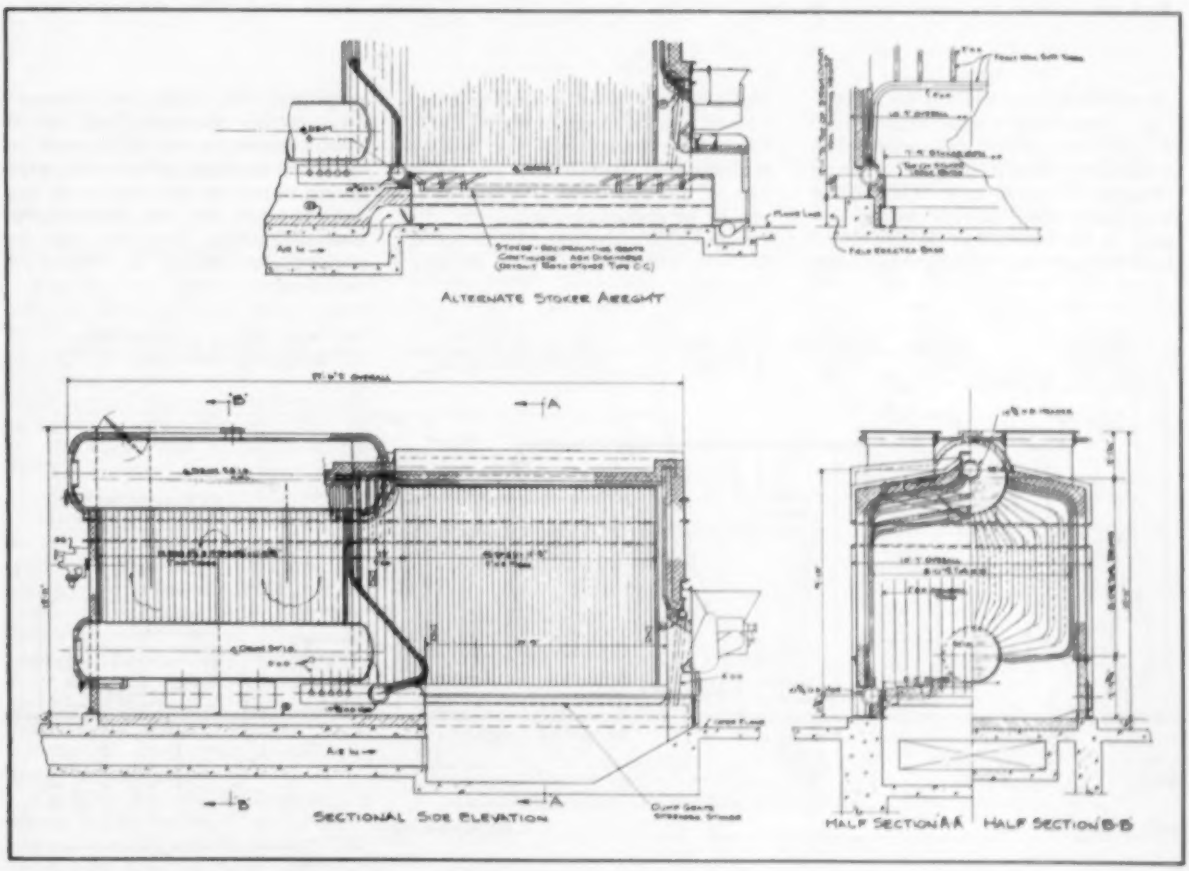
Conveying screws operating within housings carry the coal from the fuel hoppers to the ignition point in the furnace. These coal conveying screws are driven mechanically through continuous chain driven sprockets. The fuel feeding mechanisms are equipped with shear pins to protect against damage from foreign substances in the coal, and the hoppers have brackets to receive steel sprocket fuel agitators that prevent bridging of the coal.

Another type of vibrating stoker combines a pulsating type fuel bed traveling mechanism with standard spreader feeders. Angular injection of the combustion air through tube tuyeres assures good air distribution, short flame action, complete combustion at a low level in the furnace, and minimum solids carryover into the boiler passes. By avoiding a flame envelope in the fly ash area, ash remains below a plastic state. This prevents slagging difficulties despite fuel characteristics.

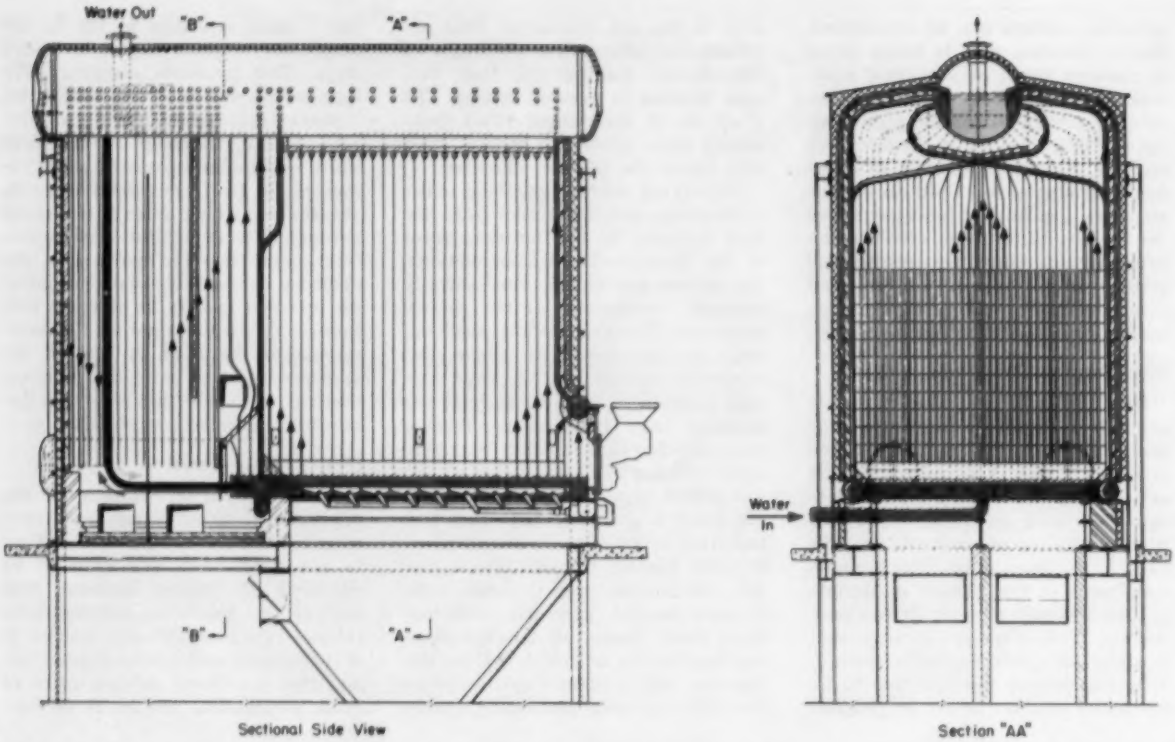
Since packaged boilers are of compact design, spreader stoker fired units will include provisions for removing fly ash from collection pockets and returning it to the furnace through jets or venturi assemblies. The value of such systems in reclaiming combustible material, proven in many plants, is already well known. Ash discharged by the stoker will be handled by any of the standard types of automatic removal systems, with selection primarily dependent on customer preference.

Heat Release Rates

With coal firing, certain of the concepts of firing range and heat transfer associated with current oil or gas fired units will have to be modified. Springfield believes that with oil and gas firing, a design heat release rate of 70,000 Btu per cu ft of furnace volume per hr is practical, and that ultimately release rates of even 100,000 Btu per cu ft of fur-



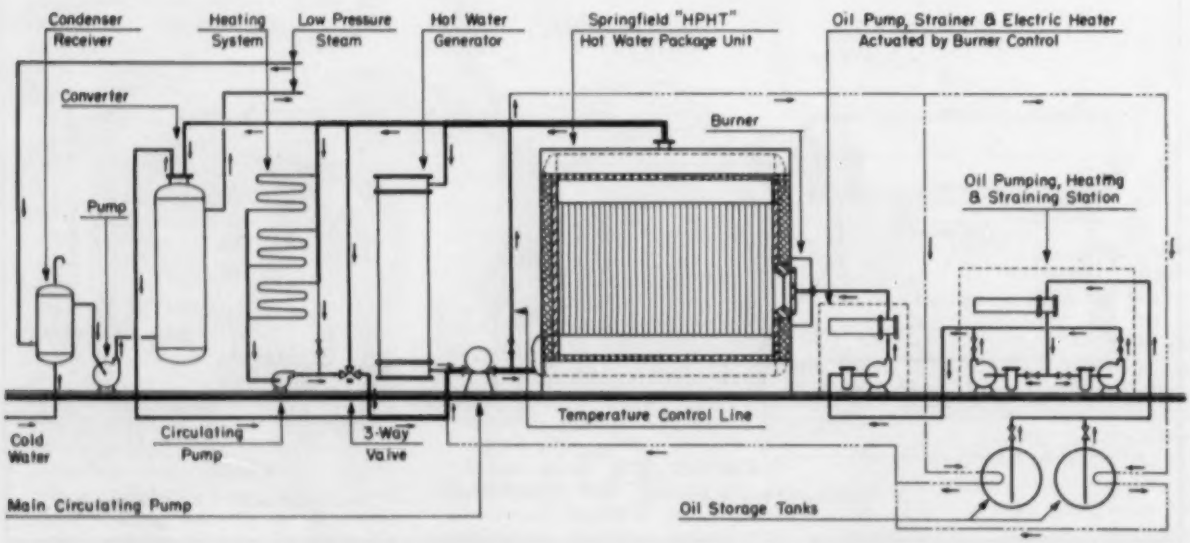
Generating units with dumping or reciprocating grate type spreader stokers include provisions for reinjecting the fly ash.



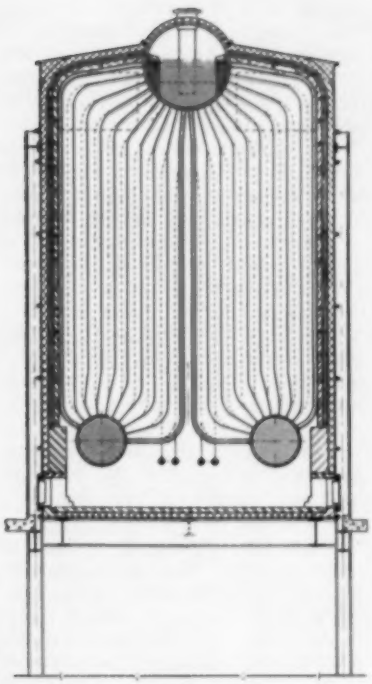
This is Springfield's new HPHT hot water unit, which also can supply steam up to 10 to 20 percent of the total heat output. Dark red sections are under forced circulation from the system's circulatory pumps. Heavy black tubes are recirculators.

nace volume per hr will be acceptable. Turndown ratios with gas or oil, or with either in combination with coal, should provide a firing range of about 20 to 1. When firing only solid fuel, current trends appear to be directed at designing for heat release rates of 45,000 to 55,000 Btu per cu ft of furnace volume per hr and a firing range of about 7 to 1. Grate heat releases will vary from a minimum of 110,000 Btu per sq ft per hr up to 800,000 Btu per sq ft per hr at maximum load.

Some provisions must be included to permit banking or to provide reignition. The preferred arrangement is the insertion of gas or oil pilot burners in the front wall to avoid the necessity of manually supplying wood, an oil torch, or live coals to ignite the coal. Most reignition difficulties, however, can be avoided successfully by employing



Schematic drawing shows typical arrangement of high pressure — high temperature hot water packaged unit heating system.



Light red indicates natural circulation induced by difference in water weight.

some method of combination firing. While the economics in many instances will dictate primary operation on coal, low load operation on gas or oil and for start-ups would offer advantages.

HPHT Hot Water Units

Besides coal firing, possibly the greatest factor influencing packaged boiler design is the increasing use of high pressure—high temperature hot water systems for space heating and special process heating with circulating water temperatures up to 450 F. Factors in favor of the HPHT system include: simplicity of pipelines; lower cost of lines due to smaller size pipes; controllability of temperatures; low rates of corrosion and erosion in pipelines and equipment; reduced cost of makeup water and chemical water treatment and equipment; less shutdowns for cleaning and repairing; and less erratic firing by reason of larger heat storage in the system. These advantages make HPHT systems more economical than steam systems for many applications.

Basically, a steam boiler generates steam, while an HPHT boiler heats water, but Springfield recently has developed dual purpose units that can do both. These units can generate steam up to 10 or 20 percent of the total heat output and also HPHT water for 80 to 100 percent of the total heat output. They employ first stage forced circulation through the tubes that enclose the furnace and second stage natural circulation in the convection section of the boiler. The steam space provided in the upper drum also serves as an expansion space, making it unnecessary to have external expansion drums in the system between the boiler and the system's circulatory pumps. Expansion vessels in the system lines are not desirable as they often lead to steam flashing.

As shown in the illustrations, the circulatory pumps force the water coming back from the system into the boiler through the water wall tubes enclosing the furnace. Since the heat level is highest in this radiant section, for hot water generation it is necessary to prevent the making of steam in the water wall tubes. If steam is made, it must be condensed by discharging the steam-water mixture from the tubes through solid water and through breakup screens. The hot water is taken out of the water space in the upper drum, thus requiring a siphon pipe from the water nozzle in the top of the drum down into the water space. Provisions are included to prevent accidental steam discharge near the water intake, and at no time can the water level drop below the intake of the siphon pipe.

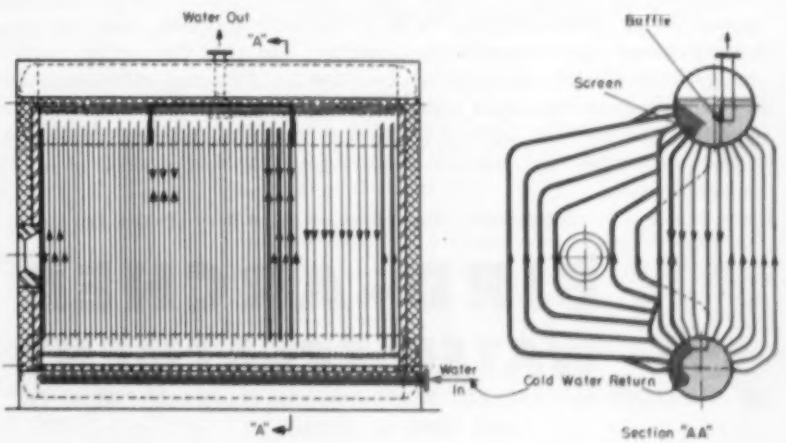
The dark red sections on the illustrations indicate the water under pressure from the system's circulatory pumps. That part of the boiler where the water circulates by natural circulation induced by difference in water weight (due to temperature difference) is shown in light red. The heavy black tubes are safety margin or recirculation tubes that will be under pump pressure during normal operation when the circulatory pumps bring back the water from the system.

Safety Margin Tubes

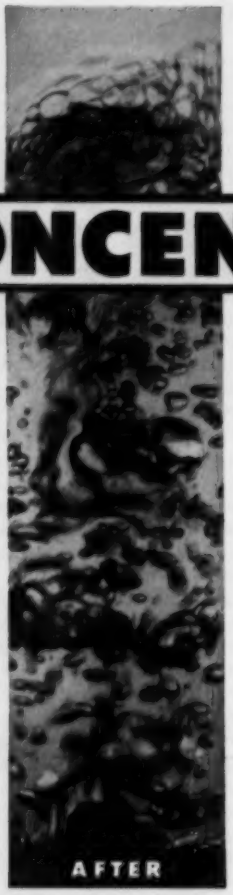
The safety margin tubes discharge near the hot water outlet in the upper drum. The outlet is provided with a baffle in front of the siphon pipe to prevent straight flow of water from the furnace tubes to the system mains. If, however, a break in the circulatory system should occur and the pump should not bring water back from the system, then the flow in the safety margin tubes will reverse and they will serve as downcomers for the pressure box in the lower drum or drums. This assures water supply to furnace wall tubes.

All water returning to the boiler is pumped into the pressure box in the lower drum through an internal distributing pipe at a pressure of approximately 8 psig above the boiler operating pressure at normal load. The furnace tube outlets discharge within an enclosed section in the upper drum, equipped with a breakup screen to reduce the size of any large steam bubbles so they will, when reduced in size, readily condense. Since the recirculator tubes are bringing water from the pressure box in the lower drum up into the enclosed section in the upper drum, cool water is constantly mixed with the water from the furnace wall tubes, supporting the condensing of steam bubbles within the area of the hot water outlet.

This recirculator tube arrangement (on which patents are pending) also makes it possible to boil out or chemical clean the boiler under natural circulation, eliminating the necessity of filling the entire



Similar color coding illustrates the circulation in another dual purpose generator.



Laboratory demonstration shows foaming of highly alkaline solution in glass test cylinder.

Same solution after addition of 12 ppm of Bird-Archer Concentrol antifoam.

CONCENTROL

LOW COST CHEMICAL METHOD

FOR CONTROLLING FOAM

AND BOILER WATER CARRYOVER

LABORATORY PROOF

● Tests and plant operating records in all parts of the country have established the effectiveness and economy of Concentrol chemical treatment to combat wet steam problems. Where boiler water carryover is caused by foaming due to high alkalinity and high proportion of dissolved solids in the water, Concentrol is essentially a surface active agent that causes breakdown of bubble film, preventing foam formation.

Concentrol is supplied in liquid, powder or briquette form—can be fed either continuously or in slugs to boilers. Formulations of Concentrol can include organic sludge conditioning agents and other water treatment chemicals for boiler treatment as well as antifoam. Concentrol eliminates the need for costly pre-treatment of water and high blow-down rate. It is fast acting and resistant to hydrolysis or breakdown under normal boiler temperatures and pressures.

A Bird-Archer 8 Point Service Engineer is as near as your phone. For friendly counsel call him or write directly to Bird-Archer outlining the details of your boiler operations.

Engineering plus Chemistry equal Bird-Archer Service

BIRD-ARCHER
WATER TREATMENT

THE BIRD-ARCHER COMPANY, 4337 NORTH AMERICAN ST., PHILADELPHIA 40, PA.
NEW YORK • CHICAGO
IN CANADA: The Bird-Archer Co., Limited, Cobourg, Ontario
IN MEXICO: Calderas y Accesorios, S. A., Amsterdam 291, Mexico, D. F.
Circle 529 on Reply Card for more data

system with acid solution or cleaning liquid. Such procedures, of course, must be conducted at low firing rates. The reverse circulation tubes also have the advantage of assuring safety if an interrupted feed from the system to the boiler should occur. Since these tubes then serve as downcomers, they would permit natural circulation in the furnace and allow the controls enough time to shut down the firing. With the failure of water return to the unit, but still taking out water from the top of the unit, the water level will drop. When low water level is reached, the low water fire cutout will shut off the firing. If, for some reason, merely the pump should stop and no more water would circulate by pump action, then the pressure will rise and the high pressure cutout will shut off the firing.

Water temperature control can be had either by firing control actuated by an aquastat in the hot water line, or by a temperature control valve in the bypass line between the pump suction and discharge. The pressure is controlled by the Pressuretrol that adjusts the fuel and air flow or firing rate by Modutrol motors. Water level is maintained by a feed pump on-and-off Magnetrol. Additional safety devices include: flame failure for oil or gas firing, low water fire cutout, high pressure fire reduction and then cutoff, and low fire automatic start.

The design lends itself to application with any of the conventional mineral fuels, and even waste products. When applied as shown in the typical system layout, the unit offers great flexibility for many service conditions. It should be noted that the circulatory pumps should be installed in duplicate so that one pump can serve as an emergency standby. Each pump should handle at least 10 percent more water than required by the heat balance and should be designed for at least 10 percent higher static pressure than required by pressure drops plus hydraulic heads on the system.

Summary

Industry can expect to see continuing development in the packaged water tube boiler field. Coal firing should become prominent, particularly in areas where solid fuels show to advantage in economic evaluation with liquid and gaseous fuels. High pressure-high temperature water systems will find expanded application, single unit capacities will increase, and there will be more designs for special service conditions, such as firing waste products.

Addressograph-Multigraph saves 29% in fuel costs burning coal the modern way

The Addressograph-Multigraph Corporation has a modern plant in suburban Cleveland. For economy and efficiency, the firm's boiler plant is coal-fired and boasts the latest in coal and ash handling equipment.

Coal offers many advantages to Addressograph-Multigraph. It is easy to handle. Only one man per shift is required to run the boiler plant on a 24-hour basis. There is no air pollution problem. And best of all is the low cost of operation! Coal costs 29.6% less than the next cheapest fuel and 35% less than the third one! With these benefits, no wonder Addressograph-Multigraph is a satisfied user of coal!

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars every year.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can result in a virtually labor-free plant.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

Circle 530 on Reply Card for more data

ideas in action

. . . in U. S. industrial plants

Testing Panel Saves Time and Repair Costs

The firm responsible for electrical operation and maintenance of the United Nations buildings, B. Eichwald & Co., Inc., has devised a means for accurately testing the hundreds of different types of electrical equipment in use in the buildings — from coffee makers to motors.

The testing equipment is mounted in a 4 x 8 ft panel fed by 3-phase, 4-wire 120-220 v current with Autrastats in each phase. Fuses in the main lines protect the feeders, and thermal cutouts limit the current to protect meters, transformers, and related equipment.

Voltages of 1 to 220 v may be obtained from the line directly, adjustments being made with Autrastats. Higher voltages of 500 to 5000 are obtained from built-in transformers. Voltmeters and ammeters are built in each phase and provide an immediate check of any equipment on test. (One ammeter and one voltmeter may be switched out of the test board circuit via a DPDT switch for any job that requires an isolated meter.) D-c voltages of 1 to 250 v are checked on a built-in meter multiplier.

Capacitors of 400 mmf to 40 mf are measured directly on a built-in bridge and sizes of capacitors required for single phase motors may be determined by a switch meter capacitor arrangement permitting capacitors of various sizes to be switched in or out.

A multiple series lamp arrangement is provided for testing lamps and fuses and for providing a low or high current series circuit for probing motor windings, relays, heaters, and similar equipment.

Panel includes apparatus for testing electrical equipment from motors to fire and smoke detectors.

A tapped transformer, which supplies circuits of 2½, 5, 6, 12, and 24 v, is equipped with a bell and buzzer for probing low voltage winding and continuity checks.

Although the test panel was designed specially to meet the electrical requirements of the United Nations buildings, a similar panel could be adapted to industrial use on perhaps a smaller scale.

Plastic Coated Rolls Increase Tin Plating Production

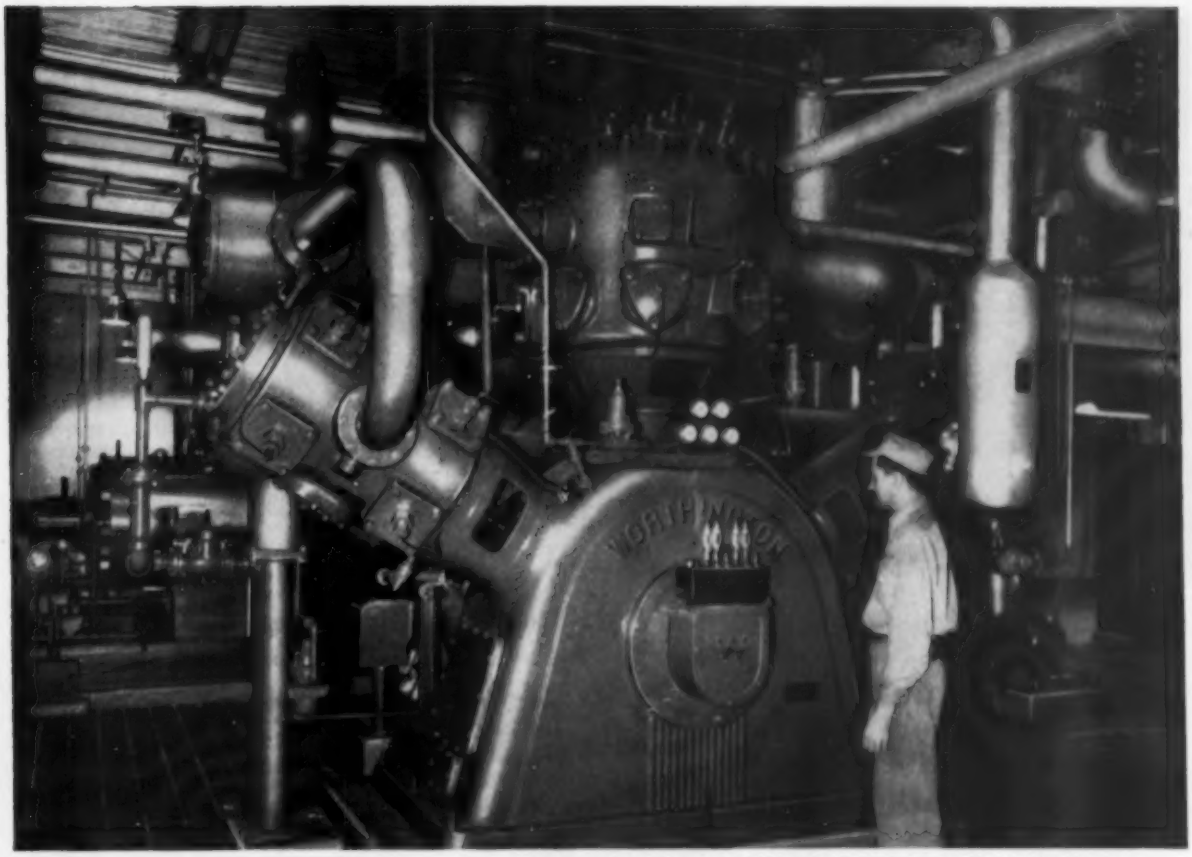
In tin-plating mills, wide, continuous strips of black steel plate are pickled, coated with commercially pure tin, and polished to a high gloss at speeds up to 4100 ft per min. Driving, guiding, and changing direction of this strip of metal is handled by various types of rubber-coated steel rolls. Attacked by elevated temperatures, moisture, abrasion, acids, and the sharp cutting edges of strip metal of various gages, these rolls require resurfacing approximately every 30 days. Under severe operating conditions, many of these rolls last only a week.

Faced by the necessity of meeting growing production demands with rolls that required constant maintenance, one of the largest tin-plate producers in the U. S. took its problem to Steel Plant Equipment Corp., Pittsburgh. The problem was complicated by the fact that nearly every type of roll in the tin-plating line required a different surface hardness. The bridle roll which prevents the rapidly uncoiling sheet steel from buckling at high speeds must have a hard surface in order to resist abrasion. The hold-down rolls are required to withstand combined effects of sulphuric acid and temperatures up to 200 F. Wiper rolls must be soft enough to remove moisture yet firm enough to resist wear. In addition, a set of insulated rolls was necessary to keep the electric charging current (for electrolytic deposition) from passing completely through the fast-moving steel strip.

From previous experience, Steel Equipment Corp. was aware that thermosetting laminated plastics filled most of the material requirements from the standpoint of mechanical strength, insulating properties, chemical and wear resistance. Synthane Corp., manufacturers and fabricators of thermosetting laminated plastics for industrial use, recommended combining a special fabric with a resin treatment which insures greater penetration of filler materials. Several types of resins, including Bakelite phenolics, were specified depending upon the type of roll, size, and function.

Once the basic fabric and resin formulas were established, covering the rolls to the required thickness was a matter of routine. Wrapping and bonding followed the same procedure that Synthane has used successfully on copper, brass, aluminum, and various alloyed metals.

Experimental rolls were stripped of their damaged rubber coating, clamped in a lathe and turned down about 1/16 in. to bright steel. The roll faces were left slightly roughened to provide a stronger bond between metal and laminate. After machining, rolls were heated to 250 F, placed on a tube-winding machine and, with the roll itself serving as a mandrel, wrapped with the special



PENNSYLVANIA POWER COMPANY gets air for soot blowing from two Worthington DYC-3 air compressors at their New Castle Power Plant.

Which is better for soot blowing — steam or air?

If we asked that question 20 years ago, the answer would be steam. But today you'd be right if you said "compressed air."

Key to the success of compressed air in soot blowing was the development of simple, automatic controls. Not only can you pre-select an operation sequence for efficient cleaning, but you're sure that the cleaning operation will be complete — and carried on only at the most efficient pressure.

Here are more reasons for using air for soot blowing:

1. Lower-cost, low-pressure, low-temperature piping — with no piping insulation required.
2. Savings on feedwater make-up.
3. Reduced blower maintenance.

For a *dependable* supply of air for soot blowing, more and more power plants — both industrial and municipal — are specifying Worthington compressors. They're equipped with the exclusive Feather* Valve — the lightest, tightest, most efficient valve made. They're designed to give more air — at less cost.

Read our Bulletin L600-B14 — "Worthington Compressors for Soot Blowing". Write for it to Worthington Corporation, Water-Cooled Compressor Division, Harrison, N.J.

* Reg. U.S. Pat. Off. K.4.6

"SEE the Worthington Corporation Exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 41st Street."

WORTHINGTON

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors

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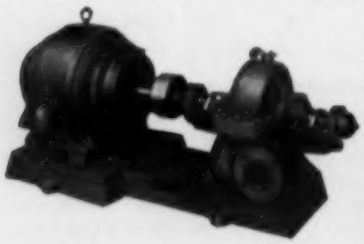
...the lifeblood of industry!

Utilize *your* water supply efficiently . . . economically . . . by equipping your distribution system with reliable, service designed WEINMAN Centrifugal Pumps.

A Weinman Centrifugal Expert is a "Doctor of Pumps" . . . whose professional skill can keep your pumping system free from "circulatory ailments" by diagnosing and curing your pumping problems before they occur . . . insuring troublefree operation at required pressures, and a constant supply at delivery points for industrial use or consumption.



WEINMAN 2-stage horizontal split-case centrifugal pumps assure adequate heads and capacities for every industrial need.

WEINMAN Pumps are backed by many years of pump-building experience . . . every WEINMAN installation is a custom installation, to handle your specific liquid-handling problems. A wide range of models are available for low and high head use . . . standard or non-clog . . . in required GPM capacities to suit your industrial needs. Talk over your pump requirements with an expert . . . a WEINMAN Centrifugal Specialist. Just write, wire or phone today.

Representatives in principal cities

Built by Centrifugal Specialists

The WEINMAN Pump Mfg. Co.

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fabric to slightly more than the required thickness.

After wrapping, the laminate-covered rolls were oven-cured at 300 F to insure complete and thorough polymerization of the wound layers. Following this, roll ends were trimmed flush and the entire assembly was finished off by being mounted in a lathe to be turned down to the exact OD specified by Steel Plant.

When returned to service, the new Synthane-covered rolls achieved a normal operating life more than three times greater than the rubber-coated rolls. Considering that the breakdown of any single roll in the tin-plating line will shut the entire line down for nearly four hours, it is evident that the greater strength of thermosetting laminates not only reduces costly downtime, but actually makes increased production quotas possible.

Electronic Control System "Masterminds" Power Station Operation

An automatic control system that "masterminds" operation of power generating stations to regulate output and frequency in accordance with electrical demand changes has been developed by the Industrial Div. of Minneapolis-Honeywell Regulator Co. The system, which uses self-correcting electronic controls, is less complicated and less expensive than earlier models.

Functioning much like an "automatic dispatcher," the system achieves accurate, high-speed control through individual servo units which supervise three different methods of control. Signals, or pulses, characterizing load swings — caused by variation in industrial demand, storms, or system changes — are telemetered to the servo units. They electronically compare the signals with the standard operating levels; if a discrepancy is detected they initiate control action — by adjusting turbine governors — to bring system load and frequency to normal.

The individual servos are interlocked, chain-fashion, to provide cumulative control of the system.

Telemetering totalizers are incorporated in the system to tally up the power measurements for area and net load readings.

The system has an unlimited range and can be built into new or existing power plants, either steam or hydroelectric. It uses wire, carrier, or microwave forms of transmission.

Power engineers from Honeywell believe that the modular — or "building block" — construction of the new system will result in relatively low-cost installations. Standardization of the basic servo units facilitate assembly and expansion as well as minimizing maintenance.

PVC Pipe and Fittings Save on "First Cost" and Maintenance

High purity water is required in large quantities at the Appliance Park plant of General Electric, at Louisville, Ky. It is used in washing G-E refrigerators with an alkali-water solution, in final rinsing operations prior to application of porcelain enamel, and in milling frit.

Two Penfield deionizer units form a central system which serves both the refrigerator unit and cabinet

YOUR CHOICE

from the world's largest line of "Y" type strainers!

- **Largest Size Range (1/8" - 10")**
- **Largest Variety of End Connections**
- **Largest Number of Body Materials**
- **Largest Selection of Screen Materials and Perforations**

— A selection of over 150 *Standard* LESLIE Self-Cleaning Strainer Body and Screen Combinations. Sizes 1/8" to 10"

— Cast iron, Bronze, Forged Steel, Carbon Steel, Carbon-moly, Chrome-moly and Stainless Steel bodies are available from stock.

— Designed for all pressure standards up to 2500 psi and 1050° F.T.T. and 6000 psi at 100° F. Screwed, socket or butt welding ends, plain, raised face or ring-type flanges for all existing standards. Sizes 1/8" to 10".

— Protect an entire piping system with a LESLIE strainer for every phase of the process. Send for bulletin 5308 for the complete story.

TRADE LESLIE MARK

SELF-CLEANING STRAINERS

LESLIE CO., 263 GRANT AVENUE, LYNDHURST, NEW JERSEY

5313

"REGULATORS SINCE 1900 — STILL FAR AHEAD IN QUALITY AND PERFORMANCE"

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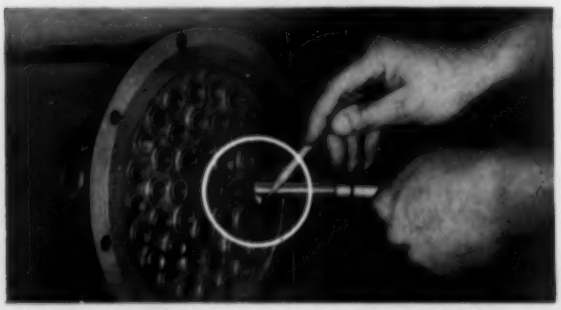
See what WILSON's done with the TUBE CUTTER!

This new Wilson Tube Cutter is making a big hit. Simple in design . . . very short . . . can be chucked into any electric or air drill . . . and the cutter bits are easily replaceable. Performance? Well, in a test on ¼"–16 gage tubes, the average time was less than 3 seconds apiece, and the cuts were practically burrless. It's a fine tool . . . and reasonably priced, too.



New Wilson Tube Cutter is easy to use and does a fast job. Cutter sizes and shanks available to meet all heat exchanger requirements.

Tube Pilot helps pass tubes through baffles and for sheet when retubing.

Tube Knockout Tools for hand or mechanical use.

DON'T FORGET!
For faster, lower cost tube cleaning
WILSON TUBE CLEANERS
For easier, better rolling of tubes
WILSON TUBE EXPANDERS

Representatives in all principal cities

THOMAS C. WILSON, INC., 21-11 44th Ave., Long Island City 1, N.Y.
Cable Address: "Tubeclean" New York

WILSON TWOSS
TUBE CLEANERS · TUBE EXPANDERS

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ideas in action

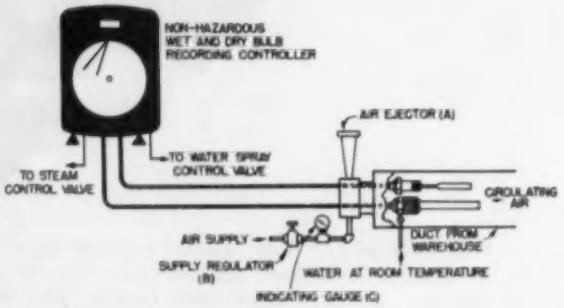
—Starts on page 72

buildings. Design of the system required a major piping installation for which Type 304 stainless steel was considered. Instead of stainless, G. E. installed unplasticized polyvinyl chloride pipe with an estimated saving of 50 percent in material cost. The corrosion resistant PVC piping carries room temperature deionized water with a 300 psi total head. Main lines are 2 in. and laterals are ¾ and 1½ in. Injection molded fittings are used in making changes in direction. These fittings, among the first to be produced commercially by the new injection molding process, are appreciably stronger than PVC fittings made by the conventional compression molding processes on a strength-to-weight basis, according to the manufacturer, Tubes Turns, Inc.

Do-It-Yourself Rig Makes Instrument Explosion Proof

Where a wet bulb humidity instrument is used for measurements in a hazardous area and the expense of explosion-proof equipment presents a problem, the wet bulb can be placed in a simple metal housing and a small air ejector used to draw an air sample over it without the use of a blower.

This method, successfully used in a large midwestern ordnance plant, can also be used in hazardous areas



Drawing shows typical installation for hazardous area.

where explosive organic vapors may be present in the atmosphere, warehouses where explosives are stored, and grain mills where dust explosions can occur.

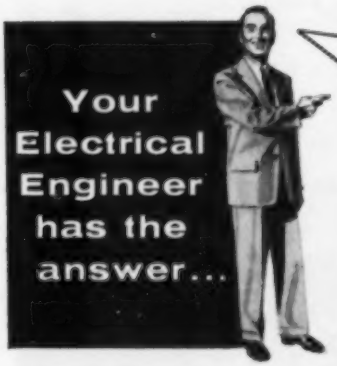
As designed by engineers at The Foxboro Co., the wet and dry bulbs of a Foxboro humidity recorder (or controller) are enclosed in a small length of stove pipe, one end open to the hazardous area and the other connected to the air ejector (a Penberthy Series 20 XL-9 or similar type). Operated by air from the plant's compressor, the ejector pulls a continuous sample over the bulb for the humidity measurement. An air supply regulator and gage provide the necessary adjustments.

The housing is easily constructed by a tinsmith, using commonly available materials, and makes it unnecessary to use an explosion-proof blower. The instrument is specified with a spring-wound instead of an electrical chart drive and can be safely located in the danger zone.

(Continued on page 94)

V.V.T.*

the "Phantom Saboteur" of Automation can cause 101 production troubles... rejects . . . without your knowing it!



* "Varying Voltage Trouble plays hob with timers, solenoids, and electronic gear in production and inspection departments. A Stabiline Automatic Voltage Regulator prevents this 'sabotage'."

STABILINE
Type SM 4118
Superior Electric offers a complete line of automatic voltage regulators. Send for Bulletin S351.

• Automatic machines and processes . . . inspection department equipment can go "haywire" every time your voltage varies — even within so-called "allowable limits". Given the opportunity your plant Electrical Engineer can spot V.V.T. and help you cure many production headaches you now consider to be "routine trouble" that you have to live with. When he recommends a Stabiline automatic voltage regulator you can be sure *these* troubles are under control.

See Superior Electric's Mobile Display when it visits your area.

THE SUPERIOR ELECTRIC COMPANY

BRISTOL, CONNECTICUT

Manufacturers of: POWERSTAT *Variable Transformers* • STABILINE *Automatic Voltage Regulators* • VOLTBOX *A-C Power Supplies* LUXTROL *Light Control Equipment* • VARICELL *D-C Power Supplies* Superior 5-WAY *Binding Posts*

THE SUPERIOR ELECTRIC COMPANY, 1803 Reynolds Ave., Bristol, Conn.

Please send me a copy of your STABILINE Bulletin S351.

Name.....

Company Name.....

Company Address.....

City.....Zone.....State.....

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readers' guide

. . . an index to advertised products

The table below lists, according to product groupings, all equipment advertised in this issue. To request more data, circle key numbers on Reply Cards, pages 34/35 & 82/83

Key No.	Advertisers	Product	Page No.
	AIR FILTERS & DUST COLLECTORS		
514	Northern Blower Co.	Dust collectors	22
	BOILERS & BOILER ACCESSORIES		
522	Cleaver-Brooks Co.	Self-contained boilers	31
502	Cochrane Corp.	Condensate drainage systems	4
526	Coen Co.	Packaged boilers	57
515	Detroit Stoker Co.	Retograte stokers	23
542	Engineer Co., The	Oil burners	84
501	Erie City Iron Works	Steam generators	90
523	Heacon, Inc.	Dampers	33
557	Liquidometer Corp., The	Liquid level gage	97
530	National Coal Association	Coals	71
512	Penberthy Injector Co.	Liquid level gages	20
540	Superior Combustion Industries, Inc.	Steam generators	82
	BUILDING MATERIALS & MAINTENANCE		
562	Flexrock Co.	Concrete floor patch	98
552	Master Builders	Pre-mixed grout	92
555	Smooth-On Mfg. Co.	Iron repair cement	94
518	Subox, Inc.	Paint system	26
	ELECTRICAL EQUIPMENT		
507	Bussmann Mfg. Co.	Dual-element fuses	12-13
528	I-T-E Circuit Breaker Co.	Low voltage switchgear	62-63
535	Superior Electric Co., The	Automatic voltage regulators	77
546	Wiegand Co., Edwin L.	Electric heating units	88
	ENGINES & TURBINES		
505	Allis-Chalmers Mfg. Co.	Turbine generator units	8-9
513	Coppus Engineering Corp.	Turbines	21
	FILTERS, STRAINERS & PURIFIERS		
560	Ronningen Mfg. Co.	Filters	97
	HEAT EXCHANGERS & WATER HEATERS		
561	Johnson Corp.	Instant heater	98
504	Patterson-Kelley Co., Inc.	Copper lined water heaters	78
536	Pick Mfg. Co.	Hot water heaters	77
541	Powers Regulator Co., The	Steam & water mixer	84
	HEATING, AIR CONDITIONING & REFRIGERATION		
516	Niagara Blower Co.	Dehumidity air conditioning	24

Pick INSTANTANEOUS HOT WATER HEATERS

ENGINEERED FOR SERVICE

Industries everywhere are replacing outmoded water heaters with Pick Instantaneous Water Heaters. Here are the reasons:

★ **Water Is Heated Instantly.** Entirely automatic, Pick Heaters operate by steam injection to heat the water in a flash to exact temperature desired and in volume required.

★ **Fuel Savings Are Substantial.** Steam injection heating is the most efficient method known. There's no waste because water is heated only as used . . . never stored and allowed to cool.

★ **No Storage Tanks Required.** Compact design of Pick Heaters permits out-of-the-way installation in corners, on walls or overhead. Saves valuable floor space.

★ **Exact Temperature Control.** Pick heaters can be operated at low or high loads with minimum temperature fluctuation. And it's done quietly.

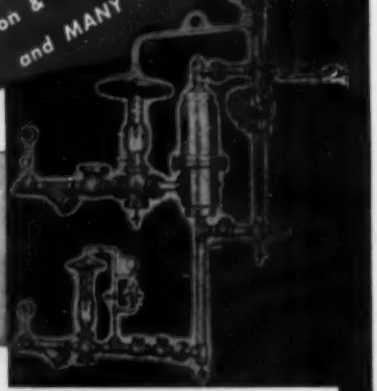
★ **Maintenance Cost Is Low.** Pick Heaters can be cleaned in a matter of minutes — worn parts easily replaced.

★ **Installation Is Inexpensive.** Only ordinary pipe connections are required.

PICK HOT WATER HEATERS . . . Used by

- United States Steel Co.
- Ford Motor Co.
- H. J. Heinz
- Bethlehem Steel Corp.
- Hercules Powder
- Wilson & Co.

and MANY OTHERS



SAVES MONEY FOR ANY INDUSTRY THAT USES HOT WATER!

Write for booklet on how PICK HEATERS cut costs of Hot Water — No Obligation. Write IP 255

PICK MANUFACTURING CO. • WEST BEND, WIS.

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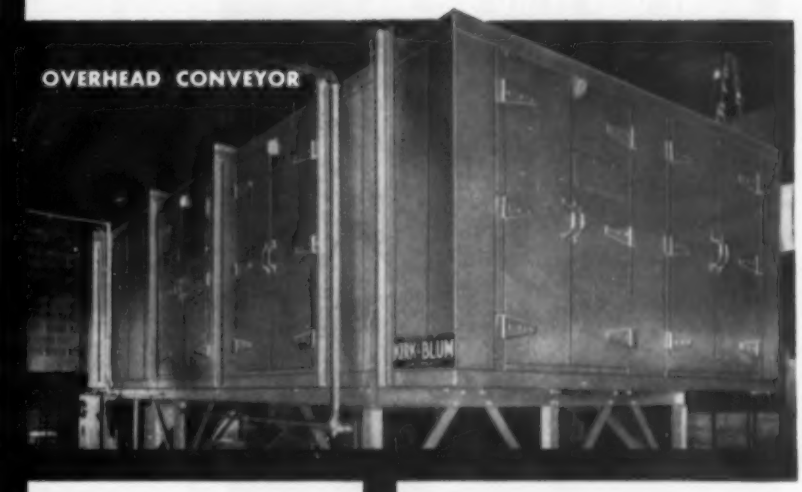
BELT CONVEYOR



TRAY

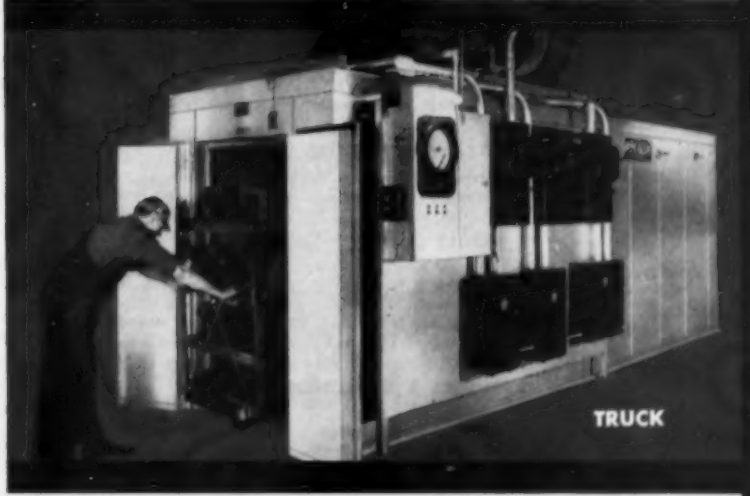
what type OVEN do you need?

KIRK AND BLUM INDUSTRIAL OVENS

Your oven needs . . . large or small, batch or conveyorized production, for drying, baking or dehydrating . . . can be filled by KIRK & BLUM.

Compactly designed and expertly engineered to meet specific requirements, these typical installations show the wide range of KIRK & BLUM experience over more than 47 years. Often, ovens up to freight car size are shipped assembled, ready to operate.

Put this skill and experience to work on your industrial oven problem. For complete information and booklet, write: The Kirk & Blum Mfg. Co., 3174 Forrer St., Cincinnati 9, Ohio.



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KIRK AND BLUM INDUSTRIAL OVENS

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this new American-Marsh CONDENSATE RETURN UNIT gives more for your money!

Compare —

FLOATLESS ELECTRODE CONTROL — Top-quality, non-corrodible stainless steel rods and tips control pump. No moving parts, no float to stick or waterlog. More accurate control — trouble free for years!

EASY TO INSTALL — Above, on or in pit below floor. Just hook up piping and cable.

TOP-QUALITY PUMP — Balanced bronze impeller, mechanical seal, requires no lubrication. Quiet-running, tremendously dependable. Impeller removable without disturbing piping. Backed by 81 years' pump building know-how!

LARGER RECEIVER TANK — Lifetime cast iron, 16 gallon capacity. Low return inlet.

SINGLE OR 3-PHASE MOTORS — To suit your current. Drip-proof, ball-bearing design, high quality.

RANGE OF SIZES, TYPES — Single or duplex — order to suit your job! *Size 1* — to 5,000 sq. ft. EDR at 20 lbs. disch. pressure — 18,000 sq. ft. at 8 lbs. *Size 2* — to 9,000 sq. ft. EDR at 30 lbs., 18,000 sq. ft. at 20 lbs.

Compare THIS UNIT — for *permanent* satisfaction in school, store, hotel, office and apartment heating systems. Then —

DUPLEX UNIT

WRITE FOR COMPLETE DATA NOW! REQUEST BULLETIN 429

AMERICAN-MARSH PUMPS
BATTLE CREEK MICHIGAN
In Canada:
American-Marsh Pumps (Canada) Ltd., Stratford, Ont.

CENTRIFUGAL, TURBINE, STEAM AND POWER PUMPS FOR TESTING, PROCESSING, BOILER FEED, FIRE PROTECTION, ETC

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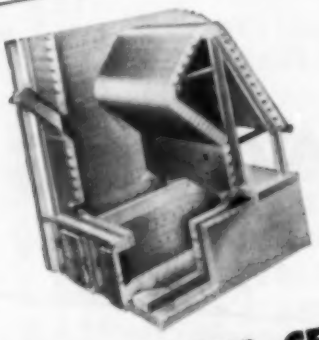
readers' guide

—Starts on page 78

Key No.	Advertisers	Product	Page No.
	INSTRUMENTS & CONTROLS		
553	Ernst Water Column & Gage Co.	Sight flow indicators	92
557	Liquidometer Corp., The	Tank gages	97
554	U.S. Gauge Co.	Special gages	93
	LUBRICANTS & LUBRICATION EQUIPMENT		
510	Manzel Div. of Frontier Industries	Force feed lubricators	18
547	New York & New Jersey Lubricant Co.	Non-fluid oil	88
519	Sinclair Refining Co.	Rubilene oils	27
564	Texas Co., The	Ursa oils	100
	MATERIALS OF CONSTRUCTION		
509	Foster Co.	Metal fabrication	16-17
537	Kirk & Blum Mfg. Co., The	Sheet metal fabrication	79
	MATERIALS HANDLING EQUIPMENT		
556	Jeffrey Mfg. Co., The	Coal handling equipment	95
550	Foster Co., L. B.	Rails and track equipment	90
	MECHANICAL POWER TRANSMISSION		
561	Dynamatic Div., Eaton Mfg. Co.	Eddy-current coupling	84
	PACKING AND GASKETS		
548	Johns-Manville Corp.	Packing & gaskets	89
	PIPE, TUBING & HOSE		
544	Atlantic Metal Hose Co., Inc.	Flexible metal hose	86
520	Vogt Machine Co., Henry	Steel fittings	29
	PUMPS & COMPRESSORS		
538	American-Marsh Pumps	Condensate return unit	80
517	Byron Jackson Co.	BJ mechanical seals	25
532	Weinman Pump Mfg. Co.	Centrifugal pumps	74
531	Worthington Corp., Water-Cooled Compressor Div.	Compressors	73
	REFRACTORIES & INSULATION		
551	Babcock & Wilcox Co., Refractories Div.	Refractory concrete	91
539	Bigelow-Liptak Corp.	Castable refractories	81
545	Universal Atlas Cement	Refractory concrete	87
	STEAM SPECIALTIES		
500	Armstrong Machine Works	Steam traps	2
524	Yarnall-Waring Co.	Impulse steam traps	34
	TOOLS		
521	Airetool Mfg. Co.	Internal tube cutter	30
549	Erie Bolt & Nut Co.	Special bolts & studs	90
503	Proto Tools	Special tools	6
559	Thread-Ezy Mfg. Co.	Power pipe threader	97
534	Wilson Inc., Thomas C.	Tube cleaners & expanders	76
	VALVES & REGULATORS		
508	Annin Co.	Control valve	15
527	Chapman Valve Mfg. Co., The	Steel gate valves	58
543	Darling Valve & Mfg. Co.	Gate valves	85
511	Keckley Co., O. C.	Solenoid valves	19
533	Leslie Co.	Regulators	75
	WATER TREATMENT & WASTE DISPOSAL		
506	Betz, W. H. & L. D.	Water conditioning	11
529	Bird-Archer Co.	Amine treatment	70
558	Hungerford & Terry, Inc.	Water treatment plant	97
525	National Aluminate Corp.	Water treatment	Between 18-19



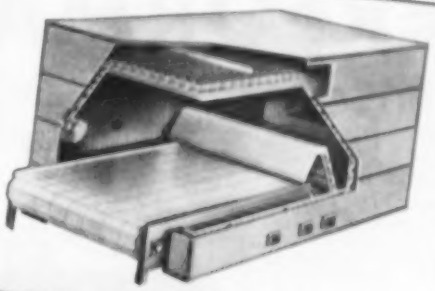
MOIST FUEL CELLS

An important application of B-L unit-suspended walls and arches is found in furnaces where a fuel with a high moisture content is burned. Although designed primarily for use in cane sugar countries for bagasse burning, these furnaces have proven so successful in other fields such as the burning of bark and wet wood refuse.

BIGELOW-LIPTAK *Corporation*

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*



DRYER FURNACES

A tough assignment for a furnace is to stand up under the every-day beating of heat in drying applications. B-L's streamlined thin wall dryer furnace does it—cuts maintenance to boot. It furnishes heat for drying coal, sugar, salt, lumber, chemicals.

BIGELOW-LIPTAK *Corporation*

LOWEST MAINTENANCE

When you specify a B-L furnace enclosure you can be sure of long life and lowest possible maintenance. Intelligent engineering and top-quality materials provide the stand-up stamina that makes enclosures "tougher than blazes." Each unit is individually designed for the job. Write today for complete information.

Castable Linings

B-L's castable lining for oil refining furnaces provides a smooth monolithic wall capable of resisting abrasion and standing up under high heat demands. The construction is adaptable to catalytic regenerators, catalytic reactors, cyclones, stacks and other refinery equipment.

BIGELOW-LIPTAK *Corporation*

UNIT-SUSPENDED WALLS AND ARCHES

BIGELOW-LIPTAK *Corporation*

AND BIGELOW-LIPTAK EXPORT CORPORATION

2550 WEST GRAND BOULEVARD, DETROIT 8, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MINNEAPOLIS • NEW YORK
PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

4180

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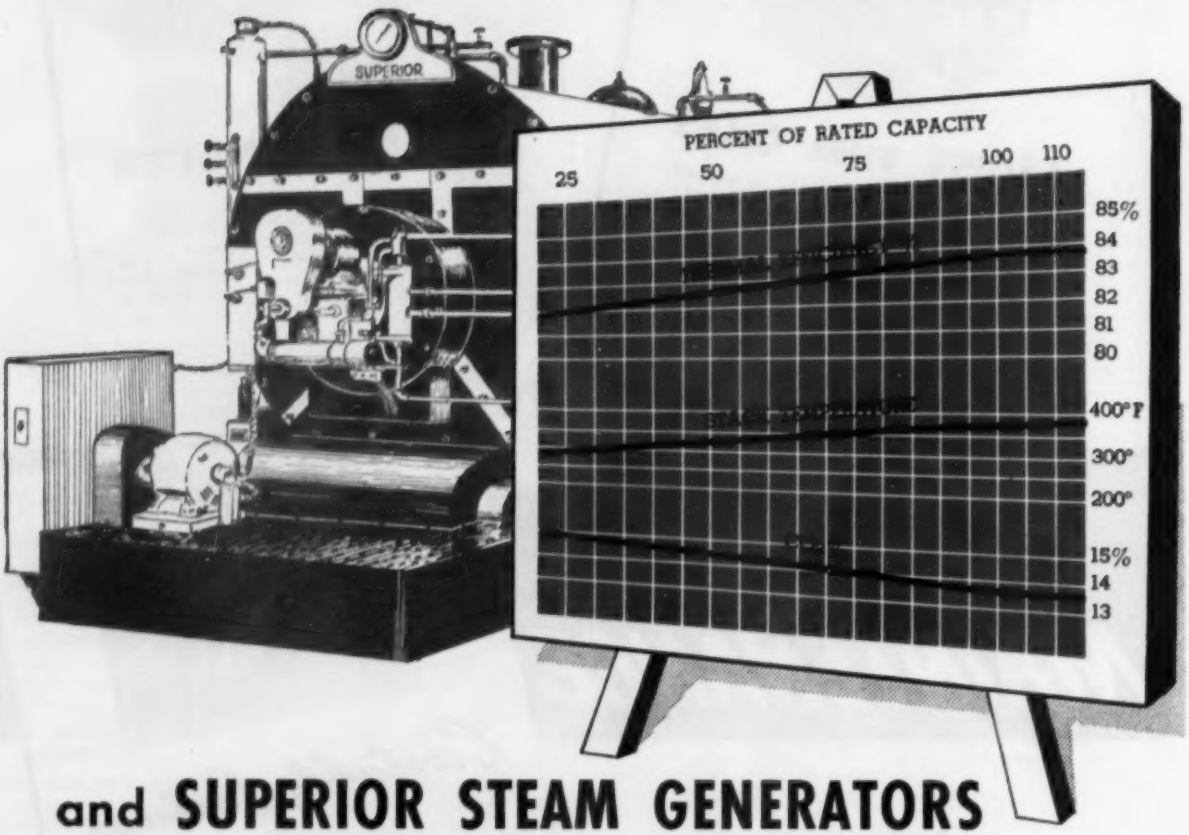
PERFORMANCE

is part of the PACKAGE



and SUPERIOR STEAM GENERATORS are rated for actual operating conditions

Superior Steam Generators are fully automatic, burning oil or gas or both. 18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. Write for catalog 702.

The payoff in performance is in your plant—here is where a steam generator must live up to the claims of its maker or you are the loser. Every Superior Steam Generator is "Performance Rated" on the basis of tests conducted under conditions duplicating those of actual service and is guaranteed on the results of these tests. The chart above shows typical performance of a Superior Steam Generator at 100 lbs. pressure. It is based on tests conducted by professors from Lehigh University on a boiler which had been in actual service for over a year. You can depend on results like these throughout a longer serviceable life when you specify Superior Steam Generators.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR STEAM GENERATORS

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bulletins

. . . for listing of the bulletins just received see page 28

AIR CLEANING & DUST COLLECTION

250—Industrial Dusts

"The Collection and Recovery of Industrial Dusts," 32-page manual 101, discusses various types of dust and techniques used in analysis, lists the factors which influence choice of equipment, and explains operation. Buell Engineering Co., Inc.

251—Pneumatic Systems

"Pneumatic Ash & Dust Handling Systems," seven-page catalog 652, outlines general principles of pneumatic materials handling and explains how this company's products meet requirements for each application. Allen-Sherman-Hoff Co.

252—Dust Collectors

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrestor types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. Kirk & Blum Mfg. Co.

253—Dust Collectors and Arrestors

Series of four folders describes cyclone type collector and portable, standard, and automatic bag-type dust arrestors. Also includes 32-page catalog describing exhaust fans for dust collecting and air handling. Northern Blower Co.

254—Air Pollution

"Stop Air Pollution with the Liquid Precipitator Multiple-Action Scrubber," four-page booklet LH12054, tells how to control dusts discharged from stacks of cyclones, rotary dryers, kilns, roasters, mixers, pulverizers, and sintering plants. Johnson-March Corp.

PRODUCT INDEX

Air Cleaning & Dust Collection 83
Air Conditioning — Heating & Refrigeration 83
Boilers & Steam 83
Building Materials & Maintenance 84
Compressors & Blowers 86
Corrosion Control 86
Electrical Distribution 86
Heat Exchangers & Water Heaters 86
Instruments & Controls 86
Lubrication 86
Piping, Valves, & Specialties 86
Power Transmission — Mechanical 88
Pumps 88
Refractories & Insulation 90
Turbines & Steam Engines 90
Waste Disposal 90
Water Treatment 90

AIR CONDITIONING-HEATING & REFRIGERATION

255—Temperature, Moisture Control

Precision control of air temperature and moisture enable you to manufacture your product in any climate, at any season, according to six-page bulletin 122. The Type "A" air conditioner is shown in typical installations. Niagara Blower Co.

256—Unit Heaters

Catalog CUH 846-A gives the complete story on Grid unit heaters. Catalog BC-1040 describes Grid blast coils for process drying. How the construction of the unit heaters prevents electrolytic corrosion is explained in booklet "Corrosion in Unit Heaters." J. D. Murray Manufacturing Co.

257—Woven Electric Heaters

Pre-Fab woven electric heaters are described in folder 1548 which illustrates typical uses and gives application data for this versatile heat source. Pre-Fab Heater Co., subsidiary of Edwin L. Wiegand Co.

258—Liquid Chillers

The wide selection of packaged liquid chillers available from this company for air conditioning and industrial application, sized from 7½ to 150 hp, are presented in bulletin C-1100-B52. Worthington Corp.

BOILERS & STEAM

259—Water-Tube Generator

Completely packaged Water Tube Type D Superior Steam Generator in 17 sizes with capacities from 8000 to 40,000 lb of steam per hr, is described in detail in eight-page catalog SM-54. Superior Combustion Industries, Inc.

260—Spreader Stokers

Spreader stokers said to be adaptable to all types and makes of modern steam boilers and generators, from 5000 to 75,000 lb per hr steam output capacity, are described in 14-page brochure 800. Various installations using Roto-Stoker Type CC stokers are shown. Detroit Stoker Co.

261—Condenser Tube Inserts

How to restore leaking condenser tubes to service by sealing off the deteriorated portion with inserts, is the subject of four-page leaflet 500. Tube cleaners, expanders, and maintenance tools are listed. Thomas C. Wilson, Inc.

262—Spinning Gas Technique

Operation and advantages of the Continental Automatic Boiler's "spinning gas technique," a method of obtaining maximum heat transfer with a simplified design, is explained in booklet BE-4. Boiler Engineering & Supply Co., Inc.

263—Package Generator

Six-page foldout B-3100 describes in detail the Ticosteam package steam generator, a three-pass constant furnace pressure, forced draft, fire tube, horizontal boiler which is fitted with burners of special design permitting use of any desired type of gas or fuel oil. Titusville Iron Works Co., Div. of Struthers Wells Corp.

264—General Catalog

A wealth of research, engineering, and manufacturing experience, gained since the founding of this company in 1880, is incorporated in the products described in four-page folder. Steam generators, heat transfer equipment, and fittings are shown. Henry Vogt Machine Co.

265—Pressure Equipment

One of the country's oldest manufacturers of equipment and accessories for plants piping steam, air, and gas under pressure, has published catalog 400, covering its line of separators, traps, and boiler trim. A condensation of catalogs 500, 600, and 700. Wright-Austin Co.

266—Boiler Baffle Data

More than 20 boiler-setting plans are shown, with an analysis of how each arrangement of tubes is baffled to meet the specific boiler design, in 20-page bulletin BW-54. The Engineer Co.

267—Water-Tube Steam Generators

Packaged water-tube steam generators, Type MH, furnished for oil or gas firing or both, with automatic, semi-automatic, or manual combustion controls, are covered in detail in 16-page bulletin MH3-54. Union Iron Works.

268—Coal-Burning Installation

"Burning Bituminous Coal the Modern Way," contains 24 pages of case histories from industries of all sizes and types. Engineering survey results for equipment include annual fuel consumption and operating costs. Bituminous Coal Institute.

269—Packaged Steam Generators

Construction of packaged steam generators is described in eight-page bulletin 1050. Auxiliary equipment is listed and a blueprint with dimensions of a typical boiler room is given. Ames Iron Works.

270—Tube Cleaners

Bulletin 43 introduces a new geared tube cleaner for removing scale in heat exchanger and condenser tubes of ¾ to 2½ in. ID. The unit is said to be particularly effective where conditions require low speed and great power. Airetool Mfg. Co.

271—Boilers and Equipment

Sixteen-page bulletin SB-50, "Erie City Boilers and Allied Equipment," describes custom designed steam generators for central station or industrial application. Erie City Iron Works.

272—Flue Dampers

Booklet 1-HEA on curtain type dampers for flue gas control explains what the damper is and does, construction, dimensions, installations, and gives case histories. Heacon, Inc.

NOTE—Each bulletin has a key number for your convenience in asking for a free, personal copy. Circle key numbers on Reply Card between pages 34/35 & 82/83.

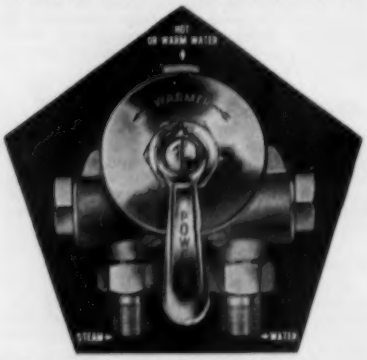
For a Small, Localized Supply of Warm or

HOT WATER

Use

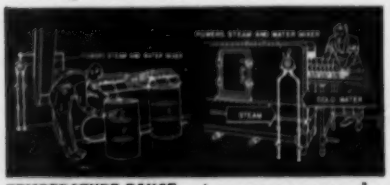
POWERS

STEAM and WATER MIXERS



ECONOMICAL—Quickly pay back their cost. Thousands now in use. *Easy to install.* Requires steam and water pressures above 10 lbs. Steam is mixed directly with water.

MANY USES—Industrial processes; 180° F. sterilizing rinse water for dishwashers; washing oil drums, trucks, etc.



TEMPERATURE RANGE—Any temperature desired between that of incoming water and 200° F.

HAS PRESSURE EQUALIZING VALVE—which prevents delivery temperature changes caused by fluctuating pressures of steam or water.

SMALL SIZE—½" pipe size can be held in the palm of the hand, weighs 12 lbs., ¾" size weighs 23 lbs.

CAPACITIES—based on steam and water at 45 lbs. pressure each, water at 60° F., and delivery temperature of 160° F.:—½" size = 3 gals. per min.; ¾" size = 8 gpm. Mixing stream with 140° F. water increases delivery about 75%. Often used as a small booster heater. ***WRITE for bulletin 369***

MAIL TO ..... (SWA)

THE POWERS REGULATOR CO.
3400 Oakton Street — Skokie, Illinois

Please Send Bulletin 369.

Name.....Title.....

Firm Name.....

Address.....

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273—Tube Expanders

Rolling and flaring tube expanders and operating accessories are listed in eight-page catalog 68. Illustrations, specifications, and recommendations are included. The Gustav Wiedeke Co.

274—Atomizing Oil Burners

The cheapest grades of oil or tar can be completely atomized and efficiently burned with Type SA steam atomizing oil burners according to 16-page bulletin 21. Models for various special uses are described. National Airoil Burner Co., Inc.

275—Soot Blowers

Bulletin 1137 gives complete information on the Model G9B blower which employs a fixed position rotating element to clean a large number of tubes by sweeping through a pre-determined arc. Diamond Power Specialty Corp.

277—Boiler Service Valves

Surface blow, bottom blow-off, water column blow-off, and connections are covered in 22-page bulletin E125, with complete specifications, materials, and dimensions of each type. Everlasting Valve Co.

278—Firing Equipment

Over 50 years of leadership in the manufacture of industrial-commercial firing equipment is reflected in 19-page general catalog 3048. Schematic drawings, layouts of typical installations are included. Petro Division.

279—Oil & Gas Burners

Advantages of preassembled oil, gas and combination oil and gas burners are listed in eight-page bulletin P-152. Units in sizes from 50 to 900 hp are listed for four common gas pressures and all grades of oil. Coen Co.

280—Package Boilers

Two-drum, bent tube package boilers for steam, and high pressure, high temperature hot water are discussed in a four-page folder. Ratings, data, and dimensions are given in table form. Springfield Boiler Co., Div. of John W. Hobbs Corp.

281—Package Boiler Controls

Specifications for the fully automatic, all electric metering type packaged control for shop assembled boilers are given in four-page bulletin 54-1088-239. Schematic drawing shows a typical packaged control system. The Hays Corp.

282—Remote Reading Gages

Eight-page catalog 246 covers in detail the three standard types of Convex Scale and Flat Scale Truscale Remote Reading Gages showing how these gages bring liquid level indication down to eye level. Jerguson Gage & Valve Co.

283—Check Your Steam Costs

"Have You Checked Your Steam Costs Lately?" This 15-page handbook is a non-technical presentation of vital interest to everyone considering merits of replacing existing boiler equipment or purchasing new equipment. Orr & Sembower, Inc.

BUILDING MATERIALS & MAINTENANCE

284—Flooring

"Handbook of Building Maintenance," gives valuable information on keeping your plant in efficient working order. Instant-Use concrete floor patch is described along with other materials for repairing floors. Flexrock Co.

285—Repair Cements

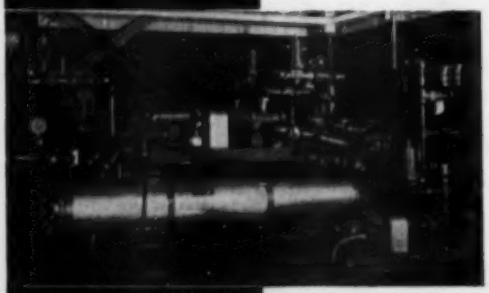
Text and illustration in this 48-page

ENCO

Fuel Oil Pumping and Heating Systems

For heavy bunker oil or light furnace oil . . . 100 to 10,000 gallons per hour

Enco systems employ one, two or more pumps and heaters, interconnected so that full capacity is possible with any combination of pumps and heaters. Flexibility of design permits the use of any combination of rotary pumps, with motor or turbine drive; or piston type steam pumps. Any part may be cut out of operation for inspection or cleaning, without shutting down, where two or more pumps and heaters are included in the unit system.



Heaters are insulated and jacketed with removable heads at both ends for cleaning without breaking any piping connections or removing any tube bundles.

Full automatic oil pressure and temperature control, with relief valves for each pump and heater. Permits delivery of oil with safety, and at proper temperature and pressure for efficient burning.

Each unit is built to order and delivered ready to place on foundation and for connection to the station piping.

Write for Bulletin OB-53 describing Enco Gas and Oil Burners; and Pumping and Heating Equipment.

THE ENGINEER COMPANY
75 WEST STREET
NEW YORK 6, N. Y.

sc 500

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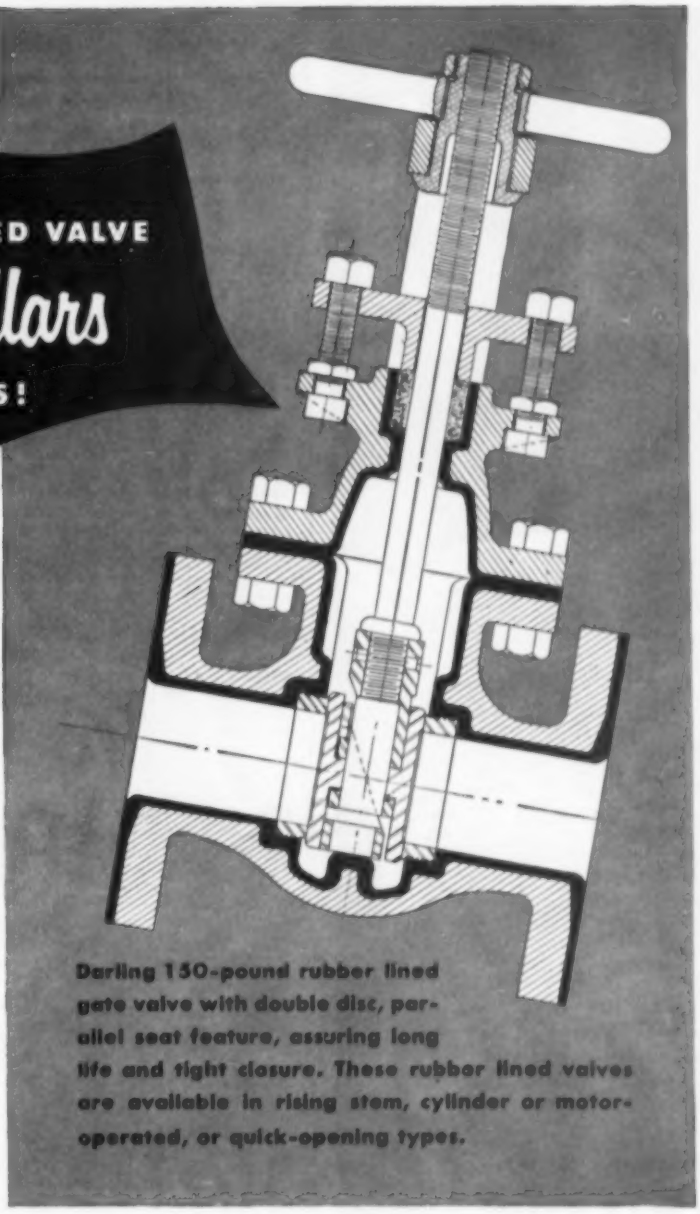
HOW THIS RUBBER LINED VALVE

stretches dollars

IN CORROSIVE SERVICES!

it's a DARLING fully revolving double disc iron body gate valve



Darling 150-pound rubber lined gate valve with double disc, parallel seat feature, assuring long life and tight closure. These rubber lined valves are available in rising stem, cylinder or motor-operated, or quick-opening types.

IN many corrosive services up to 180° F, Darling hard rubber lined iron body gate valves are taking the place of costly special alloy valves . . . saving plenty of dollars!

And when it comes to year-in, year-out behavior, they can't be beat! A proved bonding technique permanently prevents separation of the hard rubber lining from the valve body. All interior working parts are made of alloys suitable for the corrosive conditions involved.

Equally important, these valves feature Darling's fully revolving double disc parallel seat principle. This, combined with the equalizing wedges, means easy, *tight* closure even if seats are not parallel due to line stresses. It means *uniform* distribution of wear for prolonged life with minimum maintenance cost.

SEND FOR DATA. A bulletin covering Darling rubber lined *gate* and *check* valves is yours for the asking. In addition, Darling parallel seat revolving disc gate valves are available in a wide range of sizes and constructions for all kinds of normal and unusual service, and for pressures up to 1500 pounds. We'll gladly furnish specific recommendations on the proper valves for your particular service.

DARLING VALVE & MANUFACTURING CO.

Williamsport 9, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

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unequaled
for Flexible
service
For what purpose do you use flexible metal hose? To control expansion, contraction, vibration . . . to solve a misalignment, a conveying problem?
Whatever your application, you are buying flexible service. For your dollar's sake, it is well to know that Atlantic metal hose returns more flexible service than any other hose. Your own performance records will prove it.
For every application, there is an Atlantic flexible metal hose that is JOB TESTED AND CERTIFIED!
Write for Catalog 300 . . . See our catalog in Sweet's File for Product Designers.
Manufacturers of Seamless and Interlocking Flexible Metal Hose in Steel, Stainless Steel, Monel, Bronze . . . Sizes ⅛"-36" I. D. with appropriate fittings.
ATLANTIC
METAL HOSE CO. INC.
324 Dyckman St.,
New York 34, N. Y.
Circle 544 on Reply Card for more data

handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinderblocks, and sheet and plate metal. Directory describes 12 repair cements and jobs they will do. Smooth-On Mfg. Co.

COMPRESSORS & BLOWERS

286—Aftercoolers

According to four-page folder 1, wet air can be avoided by the simple installation of the Hamilton aftercooler system. Labeled cut-away view shows working parts and explains how the system operates. Jas. A. Murphy & Co.

CORROSION CONTROL

287—Transmission Line Corrosion

"Corrosion Control of Electrical Structures and Equipment," 17 pages, is designed to give practical painting information on all phases of transmission and distribution work. Subox, Inc.

288—Rubber Linings

Application of rubber lining to prevent corrosion of tanks, pipes, and valves is discussed and pictured in four-page folder. In addition, two-page reprint tells how rubber lining can stop circulating pipe corrosion. La Favorite Rubber Mfg. Co.

ELECTRICAL DISTRIBUTION

289—Air Circuit Breakers

Bulletin 5107-DR-1 contains four pages of facts, figures, features, and photographs on types KA, KB, KC, and LG Urelite air circuit breakers, and on weatherproof and dust-tight enclosures. I-T-E Circuit Breaker Co.

290—Distribution Transformers

"Allis-Chalmers Protected Distribution Transformers," eight-page bulletin 61B-7309B, gives operating advantages of the transformers available in ratings of 3 through 100 kva, 2400 to 14,400 v, and mechanical data on five type designations. Allis-Chalmers Mfg. Co.

291—Transformers

Types 136 and 236 Powerstat Variable Transformers — design, new ratings, and performance—are discussed in eight-page bulletin P354. The Superior Electric Co.

292—Fuses

Hi-Cap fuses for the protection of loads above 600 amp are described in six-page bulletin HCS. Two handy charts are included: Current Limiting Effect and Opening Time Curves. Use of these fuses in conjunction with Fusetron fuses is explained. Bussmann Manufacturing Co.

293—Dry-Type Transformers

"Latest Developments in Dry-Type Transformers," seven-page catalog 153-A, presents the advantages of air-cooled units designed and constructed primarily for inside installations. Sorgel Electric Co.

294—Power Factor Correction

Booklet 50B, 27 pages, describes the Unit-Cell Box Type Capacitors which offer easy-to-install, economical means of correcting low power factor for large or small power consumers. Sprague Electric Co.

295—Circuit Breakers

"What You Should Know About Circuit Breakers," 16-page manual 101, explains the operating principles of basic circuit breaker design. Heinemann Electric Co.

HEAT EXCHANGERS & WATER HEATERS

297—Injection Water Heaters

Steam injection water heaters with the pressurizer piston for safe, quiet, automatic control are described in four-page pamphlet WH12A. How the unit saves space, time, fuel, and maintenance costs is explained. Pick Manufacturing Co.

298—Heaters

Horizontal and vertical heaters in steel, copper lined, copper-silicon, cement lined, clad and galvanized construction, as well as the low-flow design are each cataloged as to weights, and capacities in 48-page catalog 18. The Patterson-Kelley Co., Inc.

INSTRUMENTS & CONTROLS

299—Control Devices

Photos, diagrams, and specifications for key switches, impulsing devices, switchboard lamps, and other control devices are given in 28-page bulletin 4018-D. Automatic Electric Co.

300—Electrical Controls

Redesigned for easy reference, catalog 54 commemorates this company's fortieth anniversary in the steam and electrical control field. With the description of products are included quick reference tables. O. C. Keckley Co.

301—Controls

The Gotham line of indicating, recording, and controlling instruments is summerized in four-page bulletin GL-1. Included are photos and descriptions. United States Gage Div., American Machines and Metals, Inc.

302—Control Valves

Three basic types of single seated diaphragm control valves are discussed in 15-page bulletin 5304. Cut-away views and charts with complete specification data make this a good reference book. Leslie Co.

303—Temperature Regulators

Temperature control by means of temperature regulators that combine both a pressure and thermal element is discussed in four-page folder 1008. Spence Engineering Co., Inc.

LUBRICATION

304—Force Feed Lubricator

Automatic force feed lubricator Model "94" described in 11-page booklet 94-C will pump against any steam or air pressure up to 1500 lb and will handle any grade of oil from the lightest to the heaviest. Manzel Div. of Frontier Industries.

305—Oil Filters

Eight-page bulletin F-132 describes in detail construction and operation of hydraulic systems with special emphasis on contamination of hydraulic fluids from various causes, and demonstrates the correct filtration system. The Hilliard Corp.

306—Bearing Lubrication

"Industrial Bearing Lubrication," is a reprint from the magazine **Lubrication**, October, 1954 issue. The article covers bearing design, surface, overhaul, and aspects of lubrication. The Texas Co.

PIPING, VALVES, & SPECIALTIES

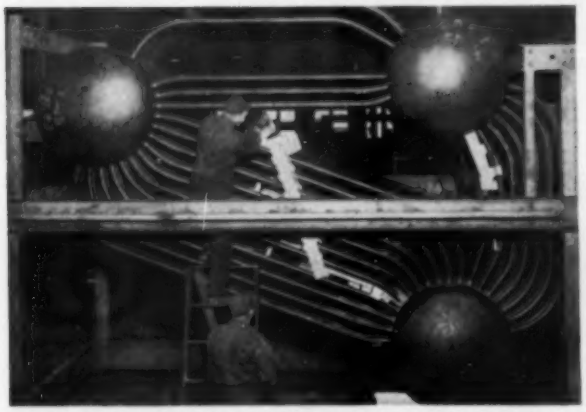
307—High and Low Pressure Valves

Catalog 10 describes List 960 and 990 valves. The 960 is for a pressure range of 200 lb at 100 F to 380 lb at 1000 F. The 990 is for higher pressures. Chapman Valve Manufacturing Co.

Torque Wrenches

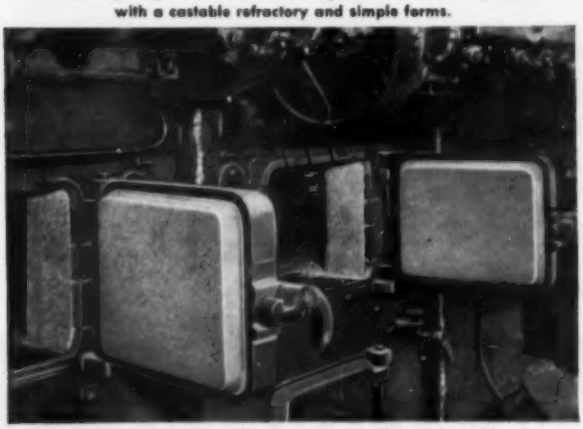
Both inch-pound and foot-pound torquers are described in this complete 68-page catalog. Types included are for a wide range of drive sizes with plain or ratchet head. **Please send requests directly**

IN POWER PLANTS ON JOBS LIKE THESE:

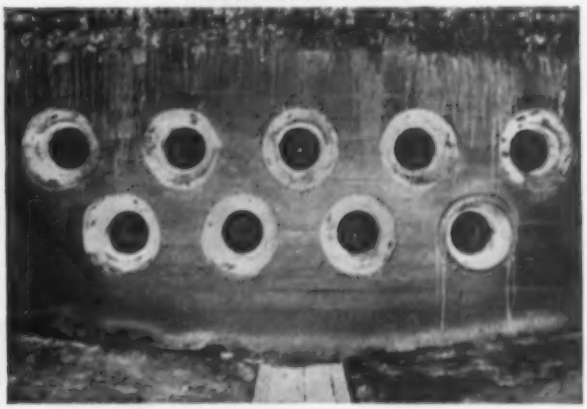


Monolithic gas-tight baffles of Refractory Concrete are easily made with a castable refractory and simple forms.

Lumnite steel stack linings keep drafts up and costly repairs due to corrosion and abrasion down.



Door linings and other special shapes are easily cast in molds with adaptable Castable Refractory Concrete.



Front wall of boiler is lined with 9 inches of Refractory Concrete—section in excellent condition after a year of service.

Castables save time and cut costs

Power-plant engineers find that castable refractories provide a fast, easy way to place or repair linings in steel stacks, breechings, boiler walls and hearths, doors, coal bunkers and ash pits. Refractory and insulating concrete made with castables can be mixed simply by adding water right on the job, and casting into place. Costs are cut and time saved because they reach service strength within 24 hours—and usually give better service than other refractories.

Castables are prepared mixes of Lumnite* calcium-aluminate cement and special aggregates selected to meet specific temperature and insulation service. They are made by manufacturers of refractories, sold through their dealers, and come ready-made for many refractory jobs.

There is no need to stock large inventories of special refractory shapes—they can be cast as needed. Keep a supply of your favorite brand of Lumnite castable on hand ready for a rush job. For more information write: Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, New York.

**"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

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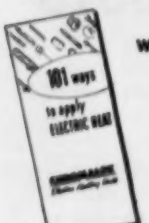

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Handbook "101 Ways to Apply Electric Heat." It suggests many uses for Chromalox Electric Heater.

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to Proto Tool Co., Dept. IP, 22782 Santa Fe Ave., Los Angeles 54, Calif., with 10c.

309—Steam Traps and Specialties

Catalog 68G, 31 pages, describes and illustrates steam traps, strainers, regulating and reducing valves, separators, and vacuum and lifting traps. Strong, Carlisle & Hammond Company.

312—Strainers

You can prevent rust, scale, and dirt from clogging steam equipment with use of Yarway fine-screen strainers, according to six-page bulletin S-204. Tables give prices, rates, dimensions, and woven screen data. Yarnall-Waring Co.

313—Solenoid Valves

If you use direct operated solenoid valves for automatic or remote flow control of liquids and steam up to 400 F, or of high viscosity liquids you will want to read 11-page bulletin V-2. Normally closed, normally open, explosion-proof normally closed, and three way valves are shown. The Johnson Corp.

POWER TRANSMISSION—MECHANICAL

315—Belt Conveyor Design

Engineering data required to design a belt conveyor for any application are presented in 96-page catalog 852. The booklet states that many problems can be answered by using a standardized unit. The Jeffrey Mfg. Co.

316—Adjustable Speed Equipment

Principle of operation and use of Dynamatic Eddy-Current adjustable speed equipment is described in 16-page bulletin GB-2. Typical torque and load curves are given. Dynamatic Div., Eaton Mfg. Corp.

317—Poly-V Drive

Design characteristics of the Poly-V drive, a single, endless belt with molded length-wise ribs, are explained in eight-page folder 6638. Manhattan-Rubber Div., Raybestos-Manhattan.

PUMPS

318—Packings

Darcova Pumcups, which permit equipment to be operated at reduced speeds, are described in two bulletins: No. 4502 on Pumcups for air or hydraulic mechanisms; and 4401 on units for reciprocating pumps. Darling Valve & Mfg. Co.

320—General Purpose Pumps

How to determine total head against which pump must operate is only one of the valuable sections in 12-page bulletin 333-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. Byron Jackson Co.

321—Suction Pumps

Centrifugal Pumps — Four-page bulletin 512-A gives complete information on the Type SB horizontally split case, double balanced suction pumps including dimensional drawings. Weinman Pump Mfg. Co.

322—Sump Pumps

Automatic sump pumps, standard series, explosion-proof, totally enclosed, and submersible type are described in four-page folder 5382. Penberthy Injector Co., Div. of Buffalo-Eclipse Corp.

323—Sewage and Sump Pumps

Comprehensive, eight-page bulletin 325-A32 is for engineers, architects, and contractors who specify sewage and sump pumps. It describes in detail three types

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New "NR" grades of NON-FLUID OILS, made specifically for all Pneumatic Tools and used and approved by most leading manufacturers of air tools — give these LUBRICATION EXTRAS:

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Where it's used: Every industrial plant can use J-M Service Sheet Packing to advantage. It's the favorite packing of thousands of plant engineers and maintenance men. Both versatile and dependable, Service Sheet makes a tight, long-lasting seal against superheated steam, air, gas, water, hot oil and ammonia, as well as many acids and chemicals.

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Your J-M Packings Distributor carries complete stocks of J-M Service Sheet and other quality Johns-Manville Packings. He can help you choose the right packing for your application. Write him for complete information and copy of folder PK-19A, "Thousands of Plants Rate It Tops." Or address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

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of pumps: The NKS Vertical Wet Pit Single or Duplex; the NKV Vertical Dry Pit; and the NKH Horizontal. American Marsh Pumps, Inc.

REFRACTORIES & INSULATION

325—Castable Refractory

Bulletin 35 describes the service whereby this company provides engineering materials and erection service for vessel lining or heat enclosure jobs. Bigelow-Liptak Corp.

326—Refractory Concrete

"Refractory Concrete Manual," 16 pages, covers basic information on recommended practice for mixing and placing refractory concrete. Lumnite Div., Universal Atlas Cement Co.

TO REQUEST FREE BULLETINS
Circle "key" numbers on Reply Card between pages 34/35 & 82/83. Your requests will be handled promptly.

327—Insulation

Six-page folder IN-150A presents the facts about Thermoflex, a refractory-fiber felt. It contains tables and information on the low conductivity factor, sound absorption qualities, chemical and thermal stability, and other characteristics of this versatile new product. Johns-Manville.

TURBINES & STEAM ENGINES

328—Low-Cost Power

If you use steam for heating, cooking, or processing, you can get power at almost no cost with the use of a Wing steam turbine, according to bulletin SW-1a. Construction of these units gives an almost infinite range of speeds, easy control by throttling. L. J. Wing Mfg. Co.

329—Multi-Stage Turbines

Smaller framed, multi-stage turbines are featured in six-page bulletin. Overspeed governor, governor valves, blades, diaphragms, and many other design features are discussed. Terry Steam Turbine Co.

330—Steam Turbine Selection

Full details of this company's steam turbine are given in bulletin 135. How to save operating and maintenance costs by buying the right size for individual needs is explained. Coppus Engineering Corp.

WASTE DISPOSAL

331—Waste Treatment

How this company has solved waste treatment problems for such industries as electro-plating, refinery, gas, and metal finishing is treated in detail in six-page booklet 70-B. Infilco, Inc.

WATER TREATMENT

332—Water Analysis

Published by a company engaged exclusively in the solution of industrial water conditioning problems, this 14-page brochure describes testing and control equipment necessary for the more common water analyses. W. H. & L. D. Betz.

333—Water Purification

"Boiler Feedwater Treatment," 19-page bulletin BFT-1, covers Inversand zeolite softeners, color process chemical softeners, and demineralizing units, including silica removal by ion-exchange. Hungerford & Terry, Inc.

334—Ion Exchangers

Strongly basic anion exchanger is presented in bulletin 57 which includes complete data on physical characteristics, exchange capacity and regeneration technique. National Aluminate Corp.

335—Filters and Strainers

Quick coupling, non short-circuiting fluid filters and strainers for water, chemicals, and oils can solve many maintenance problems for you according to four-page folder 654-MC. Ronningen Mfg. Co.

337—Boiler Water Foam

Laboratory pictures in this four-page folder show how Concentrol controls boiler water foam. Examples of its use in various industries are given along with an explanation of foaming. Bird-Archer Co.

339—Water Treatment

"Water Conditioning—One Source for Every Need," 19-page bulletin 611B, presents the wide range of products available from this company and explains how each type solves particular problems. Elgin Refinite Div., Elgin Softener Corp.

340—Hot Process Softeners

"Hot Process Water Softeners," seven-page booklet 801, includes data on hot process softeners and hot zeolite softeners. Flow diagrams, installation photos, and descriptions of each type are included. American Water Softener Co., Inc.

341—Demineralizing Handbook

"Handbook on Demineralizing," 40-page bulletin 5800-B, compares various methods of water treatment, demineralizers, and evaporators. It goes into characteristics of various types of available cation and anion exchange materials and offers data on operating costs. Cochrane Corp.

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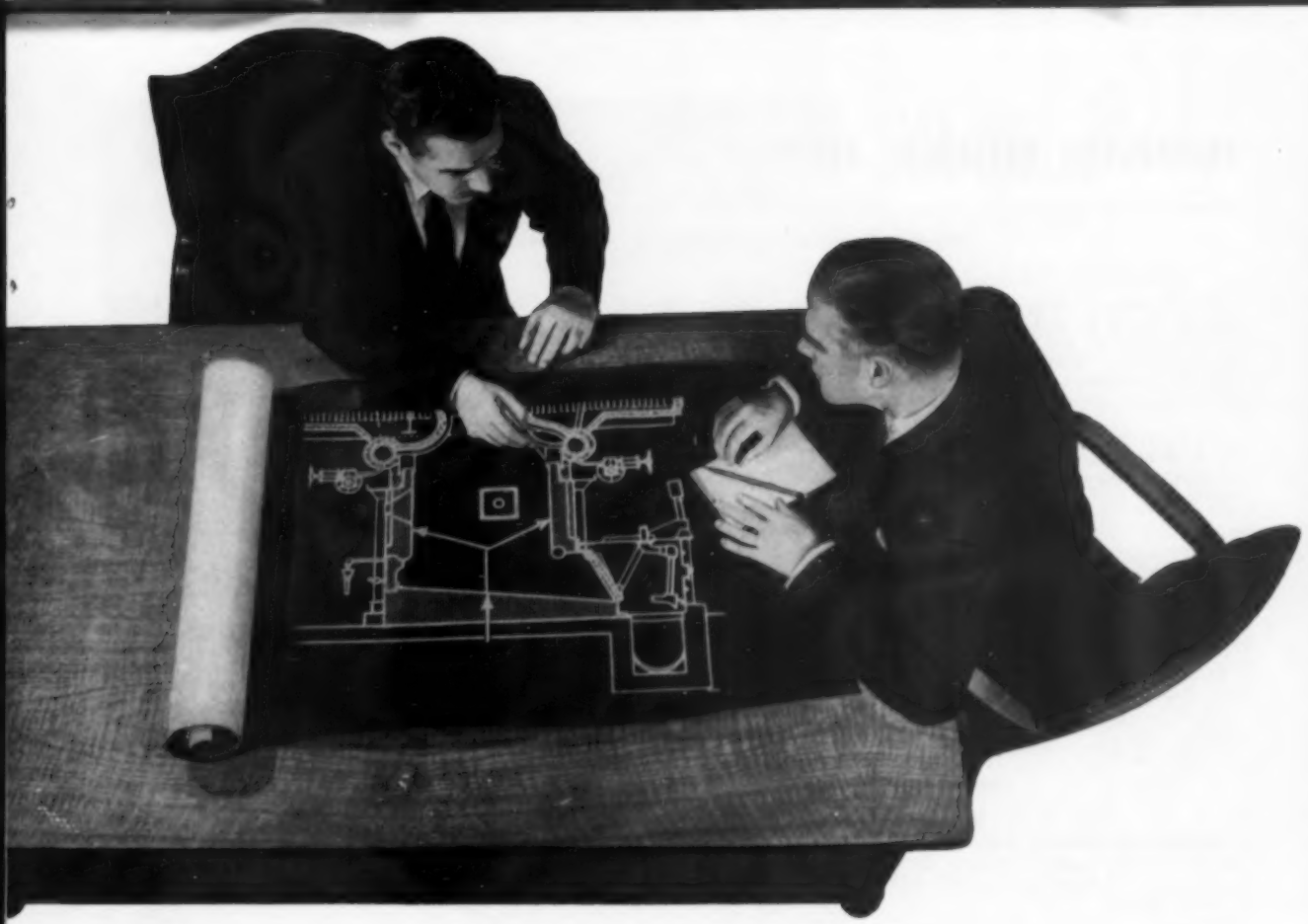

PROMINENT PUBLIC UTILITY

Cuts ashpit maintenance with B&W Refractory Concretes

A trial installation of B&W Refractory Castable "A", a 2600 degree refractory concrete, was made in one boiler ashpit. To date this castable has given 25 months more maintenance-free service than the refractories previously used.

Results of this first trial were so encouraging that another ashpit, shown in the drawing above, was lined with B&W Refractory Castable "A". In this installation the two opposing high velocity water sprays cut refractories life two ways. First, water splattered on the hot walls (about 1800F) caused spalling. Second, the high velocity water jets had an abrasive effect on the floor refractories.

Here's the report: "After 20½ months service, B&W's Castable "A" lining was still in excellent condition—far superior to the refractories used before."

On the basis of these trials three other boiler ashpits have been lined with this 2600 degree castable.

In addition to ashpit linings, B&W Refractory Castable "A" is widely used in boilers for baffles, hearths, door linings, special shapes, repairing eroded brickwork and forming pier walls in stoker-fired boilers.

B&W Castable "A" is only one of a line of B&W Refractory Concretes which cost-conscious boiler operators are putting to increasing use in many different applications. These B&W Concretes may help you cut installation costs and lengthen furnace life. Consult your B&W Field Engineer.

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R470A

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names make news

. . . personalities from industry and power

Allis-Chalmers Mfg. Co. has appointed **Frank T. Gifford** as assistant chief engineer of the switchgear dept. at the Boston Works. He succeeds **John F. Chipman,** recently named general manager of the Boston Works.

De Laval Steam Turbine Co. names **D. T. Bixby** as sales manager of its Standard Products Div. with headquarters in Trenton.

Bixby **Adams**

Raybestos-Manhattan, Inc., Manhattan Rubber Div.—James Adams, Jr. is appointed chief engineer, research and product design.

Westinghouse Electric Corp., Lamp Div.—Matthew Westphal is named works manager of the Trenton plant. **A. A. Von Melker,** former works manager, is named to the headquarters manufacturing staff in Bloomfield. Also in the Lamp Division, **John H. Max** is appointed manager of incandescent and fluorescent lamp sales.

General Electric Co.—In the Distribution Transformer Dept., **W. A. McMorris** has been appointed manager, distribution transformer advance and development engineering. He succeeds **E. D. Treanor** who retired recently.

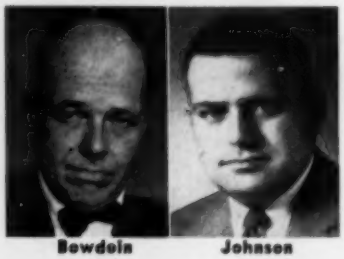
Alexander C. Boisseau is named manager of the new distribution transformer manufacturing plant to be constructed in the Hickory-Newton-Conover area of North Carolina.

International Nickel Co., Inc.—Robert M. Wilson, Jr. is assigned to act as a development engineer in the power field for the Development and Research Div.

Jeffrey Mfg. Co. has opened western territory sales headquarters with offices in the Flood Building, 870 Market St., San Francisco, Calif. **Stanley M. Mercier** is appointed manager of the office.

Joy Mfg. Co. appoints **John D. Russell** as vice president, engineering. He was formerly manager of engineering.

Worthington Corp.—George E. Bowdoin, former president of U. S. Hoffman Machinery Corp., joins Worthington as assistant to the president.



Bowdoin **Johnson**

New York Air Brake Co. appoints **Thomas W. Johnson** as director of engineering. He will be in charge of engineering for the five divisions.

Scovill Mfg. Co. appoints **Charles K. Stickney** as chief engineer of power plants and **Thomas P. Healey** as assistant chief power plant engineer.

Daniels Mfg. Co.—J. T. LaBlonde is advanced to plant engineer.

Diamond Power Specialty Corp.—Willis I. McCord, formerly with Allen B. DuMont Laboratories, is named manager of electronic sales.

EMBECO *non-shrink* **GROUT**

for setting heavy equipment

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You add only water to EMBECO PRE-MIXED GROUT to produce:

- Flowable grout that is easily placed yet...
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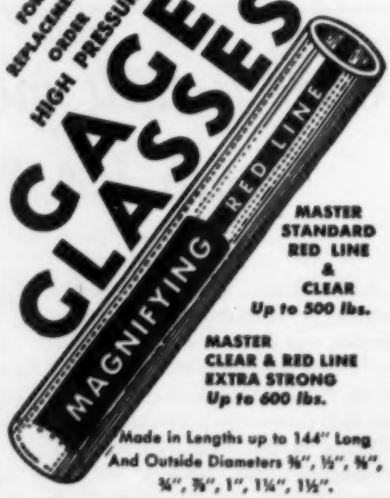

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FIG. 21—Lip Mold FIG. 22—Standard

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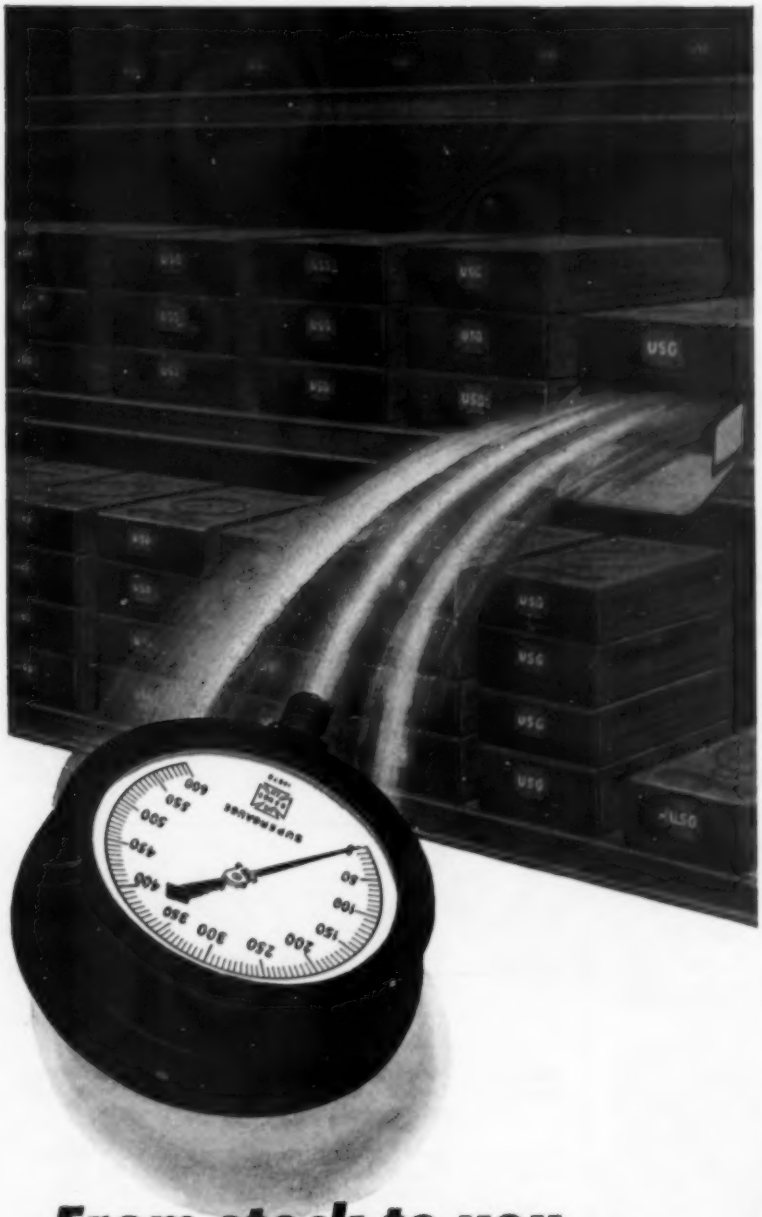

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MANY USG STOCK GAUGES ARE "SPECIALS" WITH OTHER MAKERS

For over 50 years USG has been designing and producing gauges for more original equipment manufacturers than any other instrument company in the world.

Many of USG's "special" designs have become standard stock items in the industry. Many others that are "standard stock" at USG require expensive special production with other instrument manufacturers.

To meet special gauge requirements economically, USG maintains the world's largest stock of gauge components to meet any pressure sensing and actuating need.

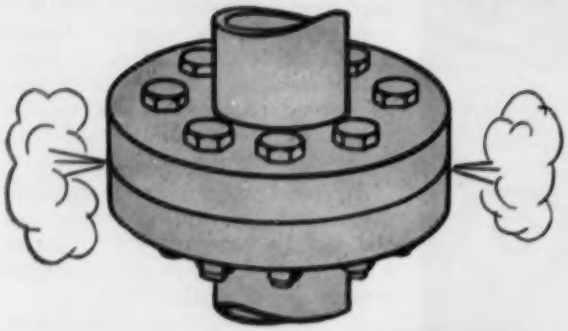
In addition to these huge stocks for special designs, USG inventories over 200,000 standard gauges in a variety of types, sizes and ranges for practically every industry application.

To assure higher quality gauges with enduring accuracy, USG maintains the most rigid quality control system in the instrument industry. This rigid inspection system is supported by a Standards Laboratory with masters measuring from low vacuums to super pressures.

USG's facilities are economically integrated for large volume, quality controlled production, assuring better gauges—with enduring accuracy—*in every competitive price class.*

Above, a portion of USG's Research Laboratory. Here constant testing of materials under customer operating conditions assures optimum efficiency and long gauge life.

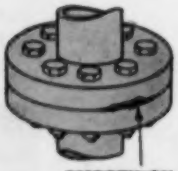
FLANGED JOINTS
which will not
LEAK



1 Make up your flanged joints with Smooth-On No. 3, heavy duty flange and gasket compound. The fine soft iron in this ready-to-use compound seals and protects. It will not bake out, it cannot be dissolved or driven away.

2 Pitted flange faces can be built up true with Smooth-On No. 1, THE iron cement. Finish with a coat of No. 3 on both sides of the gasket, and the joint is secure for very heavy duty.

3 Often a flanged joint may leak but it is impracticable to take it apart, at least not right away. Then force Smooth-On No. 1 into the leak. This hydraulic cement expands as it hardens, plugs any leak. All Smooth-On No. 1 asks is a firm surface against which to expand as it hardens.



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New, completely revised 48-page illustrated handbook shows how to stop leaks in pipes, radiators, tanks; how to anchor screws and bolts in wood, metal, concrete; how to make dozens of other time and money-saving repairs. Get a copy from your supply house or ask us to send you one postpaid.

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SMOOTH-ON

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ideas in action

—Starts on page 76

Purchasing Policy for Replacement Oils Revised

Westinghouse Electric Corp. has announced a new policy regarding purchase of replacement insulating oils used in oil-insulated apparatus such as transformers, regulators, and circuit breakers:

¶ Effective midnight June 30, 1955, users of Westinghouse oil-insulated apparatus can purchase replacement oils either direct from Westinghouse, as in the past, or from any Westinghouse-approved-brand supplier.

¶ Westinghouse-approved-brand insulating oils can be used in any combination of mixtures regardless of supplier since the oils will all comply with Westinghouse insulating oil specifications.

¶ The company will continue to ship new oil-insulated apparatus with Wemco "C" or "CI" insulating oils — composed of Westinghouse-approved-brand oils — in accordance with present practices.

¶ Westinghouse oil-insulated apparatus is to be operated only with Westinghouse-approved insulating oils. When this apparatus is operated with other than Westinghouse-approved oils, the standard warranty is void in case of trouble traceable to oil.

The employee who suggested the new purchasing policy, Robert Felt, was awarded $4375 under the company's suggestion system. He has worked at the east Pittsburgh plant for 14 yr. This was his first suggestion.

meetings

. . . and exhibitions

March 14-18	American Society of Tool Engineers (Western Industrial Exposition)	Shrine Auditorium Los Angeles, Calif.
March 20-23	American Institute of Chemical Engineers (Spring Meeting)	Kentucky Hotel Louisville, Ky.
March 28-29	American Institute of Electrical Engineers (Materials Handling Conf.)	Hotel Cleveland Cleveland, Ohio
March 28 April 1	American Society for Metals (Western Metal Expos.)	Pan Pacific Auditorium Los Angeles, Calif.
March 30 April 1	American Power Conference (17th Annual Meeting)	Sherman Hotel Chicago, Ill.
April 18-21	American Society of Mechanical Engineers (Spring Meeting)	Lord Baltimore Hotel Baltimore, Md.
May 1-4	American Institute of Chemical Engineers (National Meeting)	Shamrock Hotel Houston, Texas
May 16-20	National Materials Handling Exposition	Int'l. Amphitheater Chicago, Ill.

JEFFREY cast pulleys are better

Jeffrey Cast Iron Pulleys insure the most efficient and economical belt conveyor operation because:

- **They are more resistant to corrosion, abrasion and rust.**
- **They do not require absolutely stiff shafts.**
- **"Clamp" type hubs really grip shaft, avoid key seat wear.**
- **Heavy *machine-turned* rims are more accurate.**
- ***Machine-turned* faces are truly concentric.**
- **Variable hub positions on shaft meet all special conditions.**
- **Lagging can be vulcanized or secured with lock nuts which won't back out.**
- **Machined crown faces aid belt training, are accurate and uniform.**

Jeffrey Pulleys are cast in one piece from highest quality grey iron. There is a type and size to meet every belt conveyor requirement . . . including single or double arm, solid or clamp hubs, and extra-heavy units for high-tension belts.

Jeffrey Cast Pulleys have given trouble-free and continuous service on outstanding conveyor jobs for more than 30 years. They hardly ever wear out!

JEFFREY BELT CONVEYOR EQUIPMENT INCLUDES:

Belt Idlers — *all types*	Drive Chains
Pulleys	Pillow Blocks
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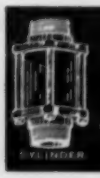
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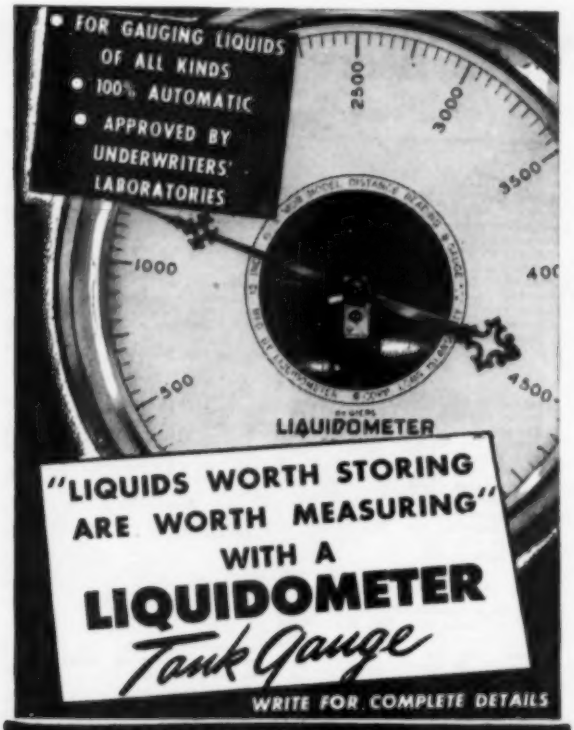

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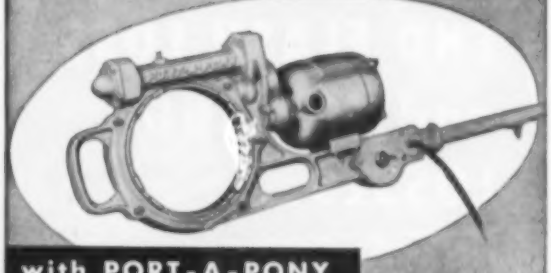

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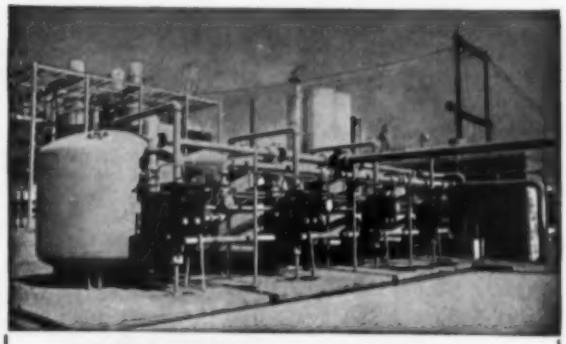

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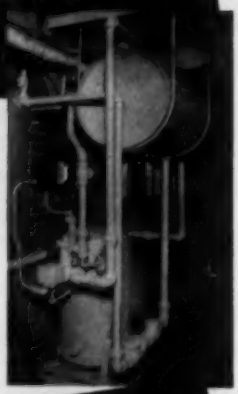

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Allis-Chalmers Mfg. Co. 8-9
American-Marsh Pump, Inc. 80
Ames Iron Works, Inc. ..... *
Annin Co. 15
Armstrong Machine Works 2
Atlantic Metal Hose Co. 86
Atlas Valve Co. ..... *
Aurora Pump Div., The New York Air Brake Co. ..... *

Babcock & Wilcox Co., Boiler Division ..... *
Refractories Division 91
Beckman, Inc., Arnold O. ..... *
Bell & Zoller Coal Co. ..... *
Belz, W. H. & L. D. 11
Bigelow-Liptak Corp. 81
Bird-Archer Co., The 70
Buell Engineering Co. ..... *
Burgess-Manning Co. ..... *
Bussmann Mfg. Co. 12-13
Byron Jackson Co. 25

Cambridge Instrument Co., Inc. ..... *
Chapman Valve Mfg. Co., The 58
Chesapeake & Ohio Railway ..... *
Childers Mfg. Co. ..... *
Cleaver-Brooks Co. 31
Cochrane Corp. 4
Coen Co. 57
Combustion Engineering, Inc. ..... *
Coppus Engineering Corp. 21

Darling Valve & Mfg. Co. 85
Dart Union Co. ..... *
Dearborn Chemical Co. ..... *
DeLaval Steam Turbine Co. ..... *
Detroit Stoker Co. 23
Diamond Power Specialty Corp. ..... *
Dynamatic Div., Eaton Mfg. Co. 99

Electric Auto-Lite Co., The ..... *
Elgin-Refinite Div., Elgin Softener Corp. ..... *
Engineer Co., The 84
Enos Coal Mining Co., The ..... *
Erie Bolt & Nut Co. 90
Erie City Iron Works 3
Ernst Water Column & Gage Co. 92
Everlasting Valve Co. ..... *

Flexrock Co. 98
Foster Co., L. B. 90
Foster Co., The 16-17

General Coal Co. ..... *

Hapman-Dutton Co. ..... *
Hays Corporation, The ..... *
Heacon, Inc. 33
Heinemann Electric Co. ..... *
Hennessy Co. ..... *
Hilliard Corp., The ..... *
Hungerford & Terry, Inc. 97

Infilco, Inc. ..... *
I-T-E Circuit Breaker Co., Small Air Circuit Breaker Div. ..... *
Switchgear Div. 62-63

Jeffrey Mfg. Co. 95
Jerguson Gage & Valve Co. ..... *
Johns-Manville Corp. 89
Johnson Corp., The 98

Kalamazoo Tank & Silo Co. ..... *
Keckley Co., O. C. 19
Kirk & Blum Mfg. Co., The 79

La Favorite Rubber Mfg. Co., Inc. ..... *
Leffel & Co., The James ..... *
Leslie Co. 75
Link-Belt Co. ..... *
Liquidometer Corp., The 97

Manzel Div. of Frontier Industries, Inc. 18
Manhattan Rubber Division ..... *
Master Builders 92
Murray Mfg. Co., D. J. ..... *
Murray Iron Works Co. ..... *

National Airoil Burner Co. ..... *
National Aluminate Corp. ..... Between 18-19
National Coal Association 71
New York & New Jersey Lubricant Co. 88
New York Air Brake Co., The ..... *
Niagara Blower Co. 24
Nicholson & Co., W. H. ..... *
Northern Blower Co. 22

Orr & Sembower, Inc. ..... *

Patterson-Kelley Co., Inc. 7
Peabody Engineering Corp. ..... *
Penberthy Injector Co. 20
Petro ..... *
Pick Mfg. Co. 78
Powers Regulator Co. 84
Prat Daniel Corp. ..... *
Proto Tools 6

Raybestos-Manhattan, Inc., Manhattan Rubber Div. ..... *
Refractory & Insulation Corp. ..... *
Republic Mfg. Co. ..... *
Rockwell Co., W. S. ..... *
Ronningen Mfg. Co. 97

Shaw Co., Benjamin F. ..... *
Sims Pump Valve Co., Inc. ..... *
Sinclair Refining Co. 27
Smooth-On Mfg. Co. 94
Sorgel Electric Co. ..... *
Spence Engineering Co., Inc. ..... *
Sprague Electric Co. ..... *
Springfield Boiler Co. ..... *
Standard Pressed Steel Co. ..... *
Strong, Carlisle & Hammond Co. ..... *
Suboz, Inc. 26
Sun Oil Co. ..... *
Superior Combustion Industries, Inc. 82
Superior Electric Co. 77

Tank Insulators, Inc. ..... *
Terry Steam Turbine Co., The ..... *
Texas Co., The 100
Thread-Ezy Mfg. Co. 97
Thermix Corp. 33
Titusville Iron Works ..... *

Union Iron Works ..... *
U. S. Electrical Motors, Inc. ..... *
United States Gasket Co. ..... *
U. S. Gauge Co. 93
Universal Atlas Cement Co. 87

Vogt Machine Co., Henry 29

Wainman Pump Mfg. Co. 74
Western Precipitation Corp. ..... *
Wiedeke Co., The Gustav ..... *
Wiegand Co., Edwin L. 88
Wilson Inc., Thomas C. 76
Wing Mfg. Co., L. J. ..... *
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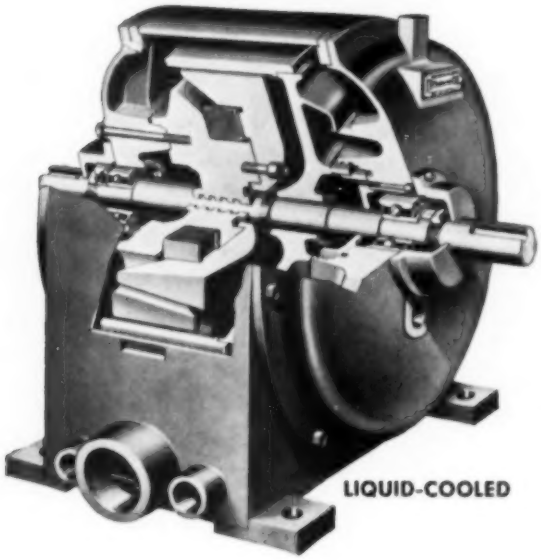

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